

Edited by ROBERT POWERS and ELAINE DAILY
World Association of Disaster and Emergency Medicine

DISASTER NURSING

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INTERNATIONAL DISASTER NURSING

The effects of a disaster on health care can range from conditions that immediately besiege the system with large numbers of patients, to catastrophes that strain its long-term sustainability. Nurses, as frontline health professionals, must have an understanding of the situations they may face before, during and after a disaster and they must develop the skills and strategies to provide effective and immediate care. *International Disaster Nursing* is the first truly comprehensive and internationally focused resource to address the diversity of issues and myriad scenarios that nurses and other health personnel could encounter during a disaster event.

This text defines the many roles of the nurse within a multidisciplinary team, and aids the implementation of the community's disaster plans in a crisis. International experts provide chapters on biological, chemical, natural, pandemic and explosive disasters. Others address disaster events and implications in the world's poorer countries; populations with special needs; ethical issues, and conducting disaster research. Important features include chapter objectives, real-world vignettes, and extensive references. With an alarming increase in the occurrence of disasters in the last decade, *International Disaster Nursing* is the hallmark text in the field.



INTERNATIONAL DISASTER NURSING

ROBERT POWERS AND ELAINE DAILY | EDITORS



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FOREWORD I

I*NTERNATIONAL DISASTER NURSING* will become a hallmark for the field of disaster health, and is testament to the broad scope of this discipline. It is a coherent summary of what we know today and the evidence upon which the science of disaster health is based. The editors of this book have assembled experts in their respective areas of disaster health who include not only the nurses to whom the text is directed, but experts from other disciplines who work in disaster health. The authors hail from fourteen different countries and, thus, truly represent the international community — the content has been guided to reflect many perspectives and health systems.

This text will serve those nurses interested in disaster planning and responses as it lays out the essential components of practice in extreme circumstances. It should help to hone the knowledge and skills of nurses participating in the continuum of emergency/disaster health care and public health from the evolution of plans to the implementation of plans in the prehospital, in-hospital, and non-traditional healthcare setting. It includes organizational aspects as well as individual and team roles and responsibilities. In so doing, the text provides essential elements required for the definitions of disaster health competencies. Importantly, the scope of the information in this book also will serve as the basis for the disaster education and training for health professionals in disciplines other than nursing. The information and its synthesis will be useful for all levels of practitioners.

The consistent format used in each of the chapters includes educational objectives and will facilitate the development of courses in disaster health. Further, the material easily can be adapted for planners and responders who are expected to perform at some of the many levels of responses required during a disaster.

In addition to core knowledge and information relevant to the practices in disaster health, several chapters address cutting-edge topics, such as disaster ethics and the design and conduct of disaster research and evaluations. Despite the fact that the field of disaster health is rife with ethical concerns and dilemmas, there are no other texts relevant to disaster health that comprehensively address the associated ethical issues. This book also provides a sound foundation for those who are or will become interested in the conduct of disaster research and the evaluation of interventions that have or will be used in disaster planning, relief, and recovery. It further develops the conceptual and operational frameworks that provide the structure for the conduct and reporting of disaster research/evaluation projects. Several chapters amplify the concepts and

information by providing concrete examples using specific events and the resultant disasters and others examine variations of methods used by different countries.

The references used by each of the contributing authors are the basis of the current evidence that exists in disaster health. Their sources not only have included the peer-reviewed literature, but also legal documents, standards, and guidelines developed by the humanitarian health community, as well as material found only in the gray literature. The contributing authors have added their respective synthesis of the current information using their expertise. What has resulted is a text with many faces and uses.

International Disaster Nursing is the first text provided by the World Association for Disaster and Emergency Medicine (WADEM). Through this publication, the Nursing Section of the WADEM has set a very high standard for future WADEM publications. The WADEM is proud to provide this extraordinary work to the health community. I congratulate all of the contributors to this compendium and especially the editors, Robert Powers and Elaine Daily, for assembling this cadre of experts and for their commitment to making this text the hallmark that it will become.

Marvin L. Birnbaum, MD, PhD

Immediate Past-President, WADEM

Editor-in-Chief, Prehospital and Disaster Medicine

FOREWORD II

DISASTERS OCCUR DAILY somewhere in the world and have a dramatic impact on the quality of life of individuals, families, and communities. The *World Disasters Report 2007* confirmed a 60% increase in the occurrence of disasters in the last decade (1997–2006) compared to the previous decade.¹ The number of reported deaths associated with disasters increased from 600,000 to more than 1.2 million while, at the same time, the number of people affected rose from 230 million to 270 million — a 17% increase. No nation, region, community, or individual is immune to the potential devastations of a disaster.²

According to the United Nations' Bureau of Crisis Prevention and Recovery, nearly 75% of the world's population live in areas that were affected at least once by an earthquake, a tropical cyclone, flooding, or drought between 1980 and 2000. In the year 2007, 133 countries were impacted by some disaster-producing event — up from an average of 116 countries during the period 2000–2006.²

Nations with less resources are particularly vulnerable and require special attention, as they are less able to finance and support disaster preparation, emergency efforts, and infrastructure reconstruction initiatives. When disaster strikes, funds are diverted from other urgently required programs. Disasters, therefore, can change the face of a resource-poor nation in minutes, wiping out years of development. Disaster reduction and sustainable development are thus closely linked.³ The data justify the importance given to sound disaster planning and mitigation efforts. Included in these efforts is the preparation of a workforce that is able to respond effectively during a disaster.

Nurses, with their technical skills and knowledge of epidemiology, physiology, pharmacology, cultural-familial structures, and psychosocial issues can and do assist in disaster preparedness programs, as well as disaster relief response and recovery activities. As team members, they can play a strategic role cooperating with health and social disciplines, government bodies, community groups, and non-governmental agencies, including humanitarian organizations. They have vital roles in prevention, mitigation, preparedness, and relief interventions. For this reason, in 2009, the International Council of Nurses and the World Health Organization/Western Pacific Region released the *ICN Framework of Disaster Nursing Competencies* — a valuable tool for education, training, and accreditation program, rosters, and deployment strategies.

There is increasing awareness of the care and support (meeting daily physical and emotional needs) that must be provided to relief workers who are experiencing human tragedy first-hand, and become stressed and fatigued, trying to

provide services with too few resources in physically unsafe circumstances. Research has documented that nurses and other care providers may experience post-traumatic stress disorders during and after a disaster. Attention must be given to their health, including accident and professional indemnity insurance coverage. The occupational health and safety of care givers must be maintained if effective health care is to be provided.

The publication of this book is timely and needed. The content covers a wide range of topics, illustrating the broad scope of disaster nursing while informing decision-making in critical aspects of disaster nursing care and preparedness planning. The learning objectives for each chapter are clearly indicated, providing easy access to specific areas of disaster nursing, including theory, practical examples, lessons learned, and recommendations for future work. *International Disaster Nursing* is a valuable reference for advancing the care provided by nurses in disaster prevention, mitigation, preparedness, and relief. Nurses have always been actively involved in such efforts. It is important to support them, advance their practice, and recognize their contributions to the well-being of our communities.

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TABLE OF CONTENTS

FOREWORD I	v
<i>Marvin Birnbaum MD, PhD</i>	
FOREWORD II	vii
<i>Mireille Kingma RN, PhD</i>	
CONTRIBUTORS	xiii
PREFACE	xxi
<i>Robert Powers, Elaine Daily</i>	
ACKNOWLEDGMENTS	xxiii
CHAPTER 1	
INTRODUCTION TO DISASTERS AND DISASTER NURSING	1
<i>Robert Powers</i>	
CHAPTER 2	
HEALTHCARE FACILITY PREPAREDNESS	13
<i>Knox Andress</i>	
CHAPTER 3	
COMMUNITY BEHAVIOR AND RESPONSE TO DISASTER	29
<i>Tricia Wachtendorf, James M. Kendra, Brandi Lea</i>	
CHAPTER 4	
FIRST RESPONDERS	41
<i>Dario Gonzalez</i>	
CHAPTER 5	
DISASTER TRIAGE	57
<i>Jamie Ranse, Kathryn Zeitz</i>	
CHAPTER 6	
HOSPITAL IMPACT: EMERGENCY DEPARTMENT	81
<i>Margaret M. McMahon</i>	
CHAPTER 7	
HOSPITAL IMPACT: IMMEDIATE ISSUES	101
<i>Hazel E. Harley, Bronwen Kelly, Muriel G. Leclercq, Andy G. Robertson, Wayne Snell, Robert B. Stewart</i>	

TABLE OF CONTENTS

CHAPTER 8	
HOSPITAL IMPACT: LONG-TERM ISSUES	119
<i>Maxim Pekarev, Kuldeep Singh, Roberta P. Lavin, Sophia Hsu, Tonya J. Broyles</i>	
CHAPTER 9	
HOSPITAL IMPACT: INTERNAL DISASTERS	139
<i>Theo J. Lighthelm</i>	
CHAPTER 10	
HEALTHCARE FACILITIES INCIDENT COMMAND	165
<i>Craig DeAtley</i>	
CHAPTER 11	
CHEMICAL PREPAREDNESS AND RESPONSE	183
<i>Yukiya Hakozaiki</i>	
CHAPTER 12	
BIOLOGICAL PREPAREDNESS AND RESPONSE	199
<i>Adrian Crowe</i>	
CHAPTER 13	
EMERGENCY MANAGEMENT OF RADIATION INJURIES AND ILLNESSES	221
<i>Doran M. Christensen, Steven M. Becker, Robert C. Whitcomb, Jr., W. Mark Hart, Steve Sugarman</i>	
CHAPTER 14	
EXPLOSIVE EVENT PREPAREDNESS/RESPONSE	253
<i>Angelo Agostini</i>	
CHAPTER 15	
DECONTAMINATION	265
<i>Robert Powers</i>	
CHAPTER 16	
POPULATIONS WITH VULNERABILITIES AND SPECIAL NEEDS	289
<i>Kelly Burkholder-Allen</i>	
CHAPTER 17	
DISASTERS AND CHILDREN	307
<i>Karen Olness</i>	
CHAPTER 18	
REGIONAL PLANNING	323
<i>Douglas Havron</i>	
CHAPTER 19	
US FEDERAL RESOURCES AND RESPONSE	335
<i>Alan D. Cohn, J. Bennet Waters</i>	

CHAPTER 20	
INTERNATIONAL DISASTER RESPONSE	351
<i>Susan M. Briggs</i>	
CHAPTER 21	
DISASTER NURSING RESPONSES IN JAPAN	365
<i>Satoko Mitani</i>	
CHAPTER 22	
PREPAREDNESS OF THE ISRAELI HEALTH SYSTEM	
FOR EMERGENCIES	375
<i>Bruria Adini, Robert Cohen, Daniel Laor</i>	
CHAPTER 23	
PUBLIC HEALTH RESPONSE	385
<i>Jane V.E. Richter</i>	
CHAPTER 24	
PANDEMIC PLANNING	397
<i>Lynn A. Slepski</i>	
CHAPTER 25	
HEALTH ISSUES IN HUMANITARIAN EMERGENCIES	427
<i>Mary Lou Fisher, Daksha Brahmbhatt, Robert Powers, Elaine Daily</i>	
CHAPTER 26	
DISASTER MENTAL HEALTH	449
<i>Margaret Grigg, Frances Hughes</i>	
CHAPTER 27	
DISASTER ETHICS	473
<i>Leila Toivaiainen, Elaine Daily</i>	
CHAPTER 28	
DISASTER RECOVERY	495
<i>Gerard J. FitzGerald, Peter Aitken, Elinor R. Davis, Elaine Daily</i>	
CHAPTER 29	
THE SOUTHEAST ASIA TSUNAMI: HEALTH ASPECTS	513
<i>Elaine Daily</i>	
CHAPTER 30	
HURRICANE KATRINA: HEALTH ASPECTS	529
<i>Anne Hutton, Helen Tilden</i>	
CHAPTER 31	
DISASTER NURSING EDUCATIONAL COMPETENCIES	549
<i>Lynn A. Slepski, Marguerite T. Littleton-Kearney</i>	

TABLE OF CONTENTS

CHAPTER 32	
DISASTER NURSING RESEARCH	561
<i>Dean Whitehead, Paul Arbon</i>	
CHAPTER 33	
DISASTER RESEARCH FRAMEWORK	583
<i>Elaine Daily</i>	
INDEX	599

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PREFACE

ALL ASPECTS OF HEALTH CARE, and all health disciplines may become involved, at some level, in the health response(s) to and recovery from a disaster. Specialized education is fundamental in preparing nurses for their evolving and expanding roles during crises and disasters. The 2007 report from the World Health Organization's Consultation on Nursing and Midwifery in Emergencies called for improved skills and competencies of nurses involved in emergencies and disasters, and for disaster nursing education to be integral in both pre-service and in-service nursing education.

Knowledge is key to disaster preparedness and effective responses. The intent of this text is to provide nurses with an in-depth, comprehensive understanding of their potential role(s) during a disaster, the issues that they may face, how the various response systems and agencies function, and the impact of these disaster response systems on the role(s) and functions of the nurse.

To this end, we have sought input from numerous experts in various fields and disciplines in disaster health. In recognition of the fact that roles and functions often blend and cross over during a disaster, we have selected authors from the disciplines commonly involved in disaster health (such as nursing, medicine, and public health) as well as governmental and non-governmental agencies. As the discipline of disaster health is fairly nascent and without a strong, evidential base, it is essential that we make every effort to share information among the involved professions and to learn from each other.

This textbook represents the current state of knowledge as compiled by experts in specific areas of disaster health. Each chapter is a synthesis of the best available science and information that exist today and forms the basis upon which we can direct our practice and advance our profession.

Disaster-producing events occur throughout the world, and while the impact and the responses may differ in different countries, many commonalities exist. We can learn valuable lessons through the examination of systems and practices used by our colleagues in other parts of the world. Thus, an additional aim of this book is to provide an international perspective that has been lacking in disaster nursing textbooks.

The text also includes chapters addressing the important emerging fields of disaster ethics and disaster research. Additionally, the text contains a chapter describing the use of a disaster research framework to help build the science of disaster health. These are original topics not addressed in other disaster nursing textbooks.

Disaster nursing responses and interventions occur at different practice levels that can be viewed as a continuum of care ranging from the very basic,

PREFACE

awareness level, to the most advanced practice. To address this range, we have attempted to provide basic care information required for safe practice during a disaster, as well as information necessary for nurse leaders and researchers. Thus, this text will be useful to nursing students as well as advanced practitioners. Educators will find the content and objectives of each chapter useful in designing curricula for disaster nursing educational programs.

The outcomes from a disaster depend on many factors. Chief among these factors is a knowledgeable and prepared workforce. As the largest representative discipline within the healthcare workforce, nurses are challenged to assume roles and responsibilities during a disaster for which they may have been previously unprepared. The aim of this textbook is to narrow the knowledge gap experienced by many nurses regarding disaster health through the enhancement of nursing knowledge and skills in order to improve the outcomes from a disaster.

Robert Powers

Elaine Daily

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Many individuals contributed to the creation of this book. We gratefully acknowledge the selfless contributions of disaster health colleagues from around the world. They have made this book what it is and what it provides to the field of disaster nursing.

We also are grateful to the World Association for Disaster and Emergency Medicine for its encouragement and assistance in bringing this book to fruition. The organization was a stalwart supporter of this project from the very beginning.

And we are indebted to the unwavering commitment and tremendous talent of Kathie Campbell Inboden, who realized the concept of this book. Her vision, her aesthetic skills, and her untiring efforts made an idea a reality.

Robert Powers

Elaine Daily



CHAPTER 1

INTRODUCTION TO DISASTERS AND DISASTER NURSING

Robert Powers

NURSES ARE OFTEN CALLED UPON to provide aid and care during a variety of disaster events, including war environments, complex emergencies with displaced populations, large-scale disasters that disrupt the normal delivery of health care to the community, and local emergencies that temporarily strain resources. In these settings, nurses utilize their unique skills, abilities, and understanding of the community to the betterment of the population by striving to deliver the highest attainable level of care that the adverse circumstances allow.

OBJECTIVES:

- Define disasters and disaster nursing;
- Describe the characteristics of disaster nursing; and
- Understand the phases of a disaster and nursing's role during each phase.

The critical thinking and problem-solving skills of nurses, coupled with their flexibility and adaptability, help provide the methods for managing the difficulties that arise during disasters, such as shortages of supplies and staff and failures in communication. Although no two disasters are exactly the same, and nurses often must be able to improvise and adapt their care practices, they must be well-versed in their potential role to effectively deliver care in a disaster. This preparation comes through education in relevant disaster topics, skills acquired through hands-on practice, interaction with preparedness procedures, and a firm understanding of local and regional capabilities and resources.

Nurses possess the necessary coordination and delegation skills which, when coupled with their care management experience, positions them to serve

capably in healthcare leadership roles during disasters. Nursing leadership may be provided through established leadership roles or through the spontaneous assumption of a leadership role by a nurse identifying and taking action to solve a particular problem.

Nurses, therefore, should be well-prepared for their potential role in a disaster setting and should participate in all phases of a disaster to the fullness of their capabilities.

DISASTERS

During disaster events, people may be without power, shelter, communication, food, and water. Emergency response capabilities can quickly become overwhelmed due to the magnitude of the damage. Injured members of the community may be unable to find transportation to healthcare facilities as the local emergency medical services (EMS) may not be able to gain access to victims or may be overwhelmed by the sheer mass of those in need. Healthcare facilities may be damaged directly during the impact and be unable to provide emergency services, or they may need to be evacuated. Those healthcare facilities that remain operational soon become inundated with more arriving patients than they have the staff or space to manage.

These events, typically, are called “disasters” by the media and by the affected community. However, many of these events are more accurately classified as an accident or an emergency if the local emergency resources, though potentially overwhelmed initially, are able to quickly manage the situation without requiring resources from other communities.¹

Disasters are events that inflict significant damage to life or property and that substantially overwhelm the local community’s resources. In some cases, the magnitude of the damage can even prevent the community from responding.

HEALTHCARE DISASTERS

Considering the increasing population density and escalating development in disaster-prone areas, the potential of disasters to impact health care is growing. A healthcare disaster is defined as: “a precipitous or gradual decline in the overall health status of a community with which it is unable to cope with adequately without outside assistance.”¹

Healthcare disasters involve a failure of the normal provision of healthcare. This may be caused by direct damage to healthcare facilities or by the large influx of patients during a disaster that overwhelms the existing healthcare services and requires outside assistance. Although opinions differ regarding classifying events such as armed conflicts or ongoing humanitarian crises as disasters,² they also can result in conditions that limit or prevent the delivery of health care.

DISASTER NURSING

Nurses comprise the largest healthcare workgroup in most countries and are at the forefront of the healthcare response to disasters. From the work of Florence Nightingale in the Crimean War to the recent care provided by nurses in the aftermath of Hurricane Katrina in 2005 and the Asian tsunami of 2004, nurses historically are linked to the provision of care during crises. Unique additions to the knowledge base of nursing, coupled with the distinct dilemmas that must be properly managed during the different phases of a disaster, necessitate the distinction of disaster nursing as its own individual specialty.

The International Council of Nurses (ICN) defines nursing as follows:

Nursing encompasses autonomous and collaborative care of individuals of all ages, families, groups and communities, sick or well, and in all settings. Nursing includes the promotion of health, prevention of illness, and the care of ill, disabled and dying people. Advocacy, promotion of a safe environment, research, participation in shaping health policy and in patient and health systems management, and education are also key nursing roles.²

THE GOAL OF DISASTER NURSING is ensuring that the highest achievable level of care is delivered through identifying, advocating, and caring for all impacted populations throughout all phases of a disaster event, including active participation in all levels of disaster planning and preparedness.

Disaster nursing provides this care, advocacy, and promotion of health within the context of a disaster. Disaster nursing is provided in numerous environments and settings, each with unique conditions with which disaster nurses must be familiar. Essential nursing abilities needed for the appropriate management of disaster victims include critical thinking, adaptability, teamwork, and leadership. Proper patient care and management in disaster settings mandates an understanding of both individual care and mass patient care. Nurses cannot be unprepared when the health care of their community is in need.

CHARACTERISTICS OF DISASTER NURSING

Caring for the Community During a Disaster

The disruptions in a community resulting from the impact of a hazardous event have varying impacts on nursing and the provision of health care. These impacts may be short- or long-term, based on the magnitude of the damage to the community and the ability of local resources to readily address and meet

the healthcare needs of the community without additional resources. During a medical disaster, nurses must be aware of the potential hindrances in delivering care and the modifications necessary to provide this care.

Whether the precipitating event is a relatively small multiple-casualty incident or a catastrophic event, the provision of health care can, at least temporarily, be overwhelmed. Nurses may be called upon to care for large numbers of patients, often at a rapid pace. Without proper planning, the response can become chaotic, resulting in less effective care delivery. Nurses must properly triage patients, ensure appropriate distribution of available nursing staff to maximize care delivery, and coordinate the appropriate distribution and placement of essential supplies and equipment.

With healthcare resources overwhelmed, the ability to provide the usual standard of care may not be possible. Unless regional plans have identified acceptable levels of care during a disaster, the nurse may face the difficult task of determining what constitutes reasonable care for the patients with the given resources. The balancing act between legal and ethical concerns and what nurses are physically capable of providing is a difficult one.

Providing nursing care during a disaster also necessitates coordinating care with other agencies and disciplines within the healthcare system, and maintaining the functionality of the healthcare facility itself. Some important roles of the nurse during a disaster are overseeing the transfer of patients to regional hospitals located away from the disaster-impacted area, assigning supplemental healthcare workers, and obtaining needed supplies.

The scope of care provided by nurses also may expand in response to a disaster. Based on the magnitude of the event, the community may be in need of food, water, and shelter. Public health nurses as well as nurses not routinely involved in addressing these basic survival needs may be called upon because of the severity of the conditions or because normal public health functions have been damaged. Nurses also may be needed to practice outside of their healthcare facility as first responders on the scene or to care for vulnerable populations during a disaster.

An ineffective nursing response can negatively impact the community's outcome from a disaster by failing to appropriately match nursing resources with need. Nurses must be well versed in strategies for overcoming disaster-induced adversities, and fully understand the different roles they may be required to embrace in order to deliver care effectively in a disaster setting.

Personal Impact

In a disaster, nurses may witness and be affected by troubling images around them. Regardless of the emotions elicited by these images, nurses' perseverance in providing needed care in times of a disaster is vital to the community's outcome.

Nurses working in disasters also may experience losses of their own. Due to a lack of communication or the pressing need of their duties, they may not know the status of their family or friends. The nurse's family, in turn, may not know the welfare of the nurse until after the disaster has abated.

There also may be increased physical demands during a disaster, such as working long shifts in abnormal, difficult conditions. One quandary for health-care workers in disasters is providing care to others while taking measures to care for their own needs. Nurse leaders must incorporate care for the nurses into disaster planning. This should include strategies for rotating staff, measures to obtain and provide information about family to the nurses on duty, and ensuring the availability of immediate support for those having difficulty coping. Nurses, in turn, must understand how a disaster could affect them, both immediately and in the long-term, and develop coping strategies and support networks to care for themselves and their colleagues within the nursing community.

Adverse Conditions

The nature of a disaster can cause adverse environmental conditions, such as flooding or high winds. Structural damage from events such as earthquakes can render the healthcare facility a potentially unsafe environment. Weather conditions, e.g., flooding, can result in the closing of community medical centers and hospitals, and in difficulties in receiving and evacuating patients. These weather conditions and the damage they cause, also can hamper the arrival of assistance and increase the isolation of the affected community from healthcare response. Nurses working in disasters should be aware of potential hazards and incorporate these considerations into planning and response.

Lack of Recognition

In some parts of the world, nurses are not allowed to voice their ideas nor are they allowed to participate in administrative decision-making. This may be more pronounced in the arena of disaster healthcare, in which planning and response decisions may be made by other disciplines, and in which disaster nursing may not be well-integrated. This results in a detrimental delivery of care to the community during a disaster. The importance of the contributions of nurses often is not understood by other members of the medical community or by other sectors of the community despite the fact that, in many instances, nurses may be the only healthcare workers providing care in a community. Frequently, they are at the frontlines of a disaster, and have significant insight into the immediate needs of the community.

Nurse representatives must be included in discussions concerning their community and regional healthcare disaster plans, and their input should be mandated and integrated by emergency planners and healthcare leaders. The active cultivation of nursing insight and innovative thinking into disaster

planning and preparedness will ensure that nursing care will be provided, to the good of the community.

Critical Thinking

Critical thinking and problem-solving are crucial skills in managing the effects of a disaster. Nurses begin learning critical thinking skills early in their careers as they assess and determine patient needs, then apply and adapt nursing care to meet those needs. The application of critical thinking to the disaster setting is one of nurses' substantial strengths and, if properly directed, can be of substantial value to the overall healthcare response.

With a strong knowledge base of the community and its potential resources, nurses are in a key position to assist with the necessary problem-solving required during a disaster. Possible problems to address include creating alternate ways to obtain needed supplies when the normal routes are unavailable, or determining non-traditional locations to position bases of community care to serve the disaster-affected population.

When issues related to direct patient care and care management arise, the value of nurses' critical thinking skills becomes unequivocal. Ineffective triage, unrecognized injuries or changes in a patient's condition, lack of documentation, and poorly managed transfers to the operating room or to regional hospitals all can negatively impact the community outcome. Nurses have the ability to recognize these and similar complications of disaster response, and affect corrective action through their critical thinking and problem-solving skills.

These same critical thinking skills are major contributions nurses can bring to all levels of disaster planning, preparedness, and evaluation. Perceiving gaps in current disaster plans and envisioning improvements for greater functionality are valuable components of nurses' critical thinking capabilities. Although these strengths of nursing may be overlooked because of the difficulty in defining or measuring them, nurses in disaster settings should fully utilize these skills toward the improvement of the care delivered and, ultimately, of the overall disaster response.

Adaptability

Because of the rapidly changing circumstances during a disaster, adaptability is essential. Flexibility and adaptability increase the nurse's capacity to function efficiently and effectively during disaster events.

Nurses may need to provide care in a crowded emergency department (ED), or at the scene of the event, or in a quickly converted hospital cafeteria, or in a makeshift tent. During a disaster, healthcare locations are not static and nurses may need to shift locations multiple times as the conditions change.

Shortages of, and problems with, equipment also necessitate adaptability. Nurses may be required to provide care without the usual provisions. Dim or

no lighting, lack of electrical power, and difficulties with communication systems are issues that nurses may face and have to adapt to during a disaster; these conditions may be intermittent and require frequent re-assessments and adaptations.

Creativity often emerges during the process of adaptation as nurses combine their critical thinking skills with the needs of the current situation. For example, shortages of supplies may lead to improvised methods of sharing the limited equipment between patients, or using a different method or resource to perform the same function. Improvisation is spontaneous, but must be grounded in solid nursing knowledge and experience to provide the appropriate modifications for the situation.

Flexibility related to the variety of assigned or improvised tasks nurses perform will be needed; these tasks may range from direct patient care to leading the healthcare facility or community disaster effort. Some of these roles are developed well before the disaster through careful disaster planning; other roles develop spontaneously because of an identified need during a disaster. These roles also may change abruptly, and the nurse may be adapting hastily, moving from one role to the next in response to the shifting needs.

Leadership

Nurses must fully utilize their leadership abilities to coordinate and organize efforts during all stages of a disaster. Nurses in leadership positions are necessary not only to properly manage other nurses involved during a disaster, but also to address the overall healthcare response.

In a disaster response, nurse leaders oversee the effectiveness of that response; they are the coordinators who use their experience and knowledge to shape the disaster effort — coordinating personnel as well as supplies and resources. They may reallocate nurses, supplies, and equipment to fill gaps in the response effort, or reinforce areas that are being overwhelmed, e.g., redirecting patient flow in the hospital to prevent patients from bottlenecking unnecessarily while they await treatment. These changes often are made as the nurse leader interacts with other services and refines the response effort.

Community-wide responses, such as the establishment of shelters or fever clinics, also are implemented through nursing leadership. The nurse leader ensures that the healthcare facility — be it hospital, medical clinic, or community center — is adequately and appropriately addressing the needs of the community. Critical to this effort is the involvement of nurse leaders in all disaster planning and preparedness to ensure that their leadership experience is incorporated before a disaster occurs. Utilizing nurses' management knowledge and experience will help disaster planners and hospital administrators foresee problems and correct them well before these problems negatively impact the response.

Ideally, nursing roles and positions in disasters are pre-established by careful disaster planning. However, in the absence of a designated leader, a nurse who begins to coordinate and delegate responsibilities in an attempt to overcome an identified response shortcoming may spontaneously assume a leadership role. The individual nurses who solve problems related to a multitude of issues throughout the disaster response also demonstrate nursing leadership skills. Without strong leadership, the effectiveness of the disaster response will be severely limited. Nurses possess the necessary coordination and delegation skills which, when coupled with their care management experience, position them to capably serve in healthcare leadership roles during disasters.

During a disaster, the population is in a period of need and there is no large group of healthcare workers better poised to care for them than nursing. Nurses must clearly understand and practice beforehand their potential role in a disaster and have the necessary disaster education and skills to be in a position of readiness. Nursing knowledge and care skills coupled with their strengths of flexibility, teamwork, critical thinking, and leadership will be crucial in addressing the healthcare needs of the disaster.

Nursing in the Phases of Disasters

Disaster management encompasses the efforts to deal with hazards and the disasters they may produce. It is divided into three phases: preparedness, relief response and recovery. Each phase is an integral component of a holistic approach to an effective healthcare response. To be truly successful in their role of providing care during disasters, nurses must be involved integrally in all phases.

Preparedness

This phase involves the planning and preparedness activities performed prior to a disaster. Mitigation initiatives are specific preparedness strategies designed to reduce the losses from disasters, e.g., building earthquake-resistant hospitals. Planning begins with a hazard-vulnerability assessment, which is an analysis of the particular risks that a specific community and its healthcare system could face. Preparedness efforts are guided by these identified risks; in other words, planning focuses on preparing for those hazards that are most likely to occur in that given community.

Effective preparedness hinges on the development of a well-organized disaster response plan. In many countries, nurses are not allowed to contribute to this essential plan due to a lack of professional recognition and/or gender issues. However, when local or regional leaders work to design the healthcare response, nursing involvement is crucial to guide the planning toward effective health care during a disaster. Nursing expertise can guide plans by evaluating and

redesigning ineffective care strategies, assuring proper utilization of nursing potential, and ensuring efficient and cohesive patient flow throughout the healthcare facility and the community.

Training and practice are essential components of the preparedness phase. Drills provide an opportunity to identify areas within the disaster plans that need improvement. Education, coupled with the hands-on practical experience during drills, provide nurses with confidence in their capabilities by rehearsing and familiarizing them with their potential disaster roles and responsibilities.

Relief Response

The healthcare relief response to a disaster encompasses the broad scope of those actions intended to provide immediate health care to the community and begins with the initial notice of an impending or actual event. Often, the first notification of an event that healthcare facilities receive is not a radio call from an EMS crew on the scene, but, rather, the sudden, unannounced influx of arriving patients. Gradual onset events, such as emerging infectious diseases, tend to begin slowly but increasingly overwhelm healthcare resources as more patients develop symptoms and seek care. The ED triage nurse or the public health nurse may be the first to recognize the impact on health care and determine appropriate care as they call for the implementation of the emergency response plan. In the instance of chemical, biological, or radiological attacks or accidents, nurses may be involved in the immediate role of decontamination, setting up showers, and donning chemical suits and respirators.

Occurring simultaneously and in synergy with patient care, is the coordination of the response so that all of the healthcare facility's resources, including the nursing staff, are utilized to their fullest. This draws upon the work put into the disaster planning phase by following the procedures for establishing the hospital emergency operations center, implementing staff recalls, creating surge areas, and maintaining supply deliveries to the facility.

Outside of healthcare facilities, nurses also will be integrally involved in assessing community needs; providing shelter; food, and water; establishing and staffing vaccination or distribution centers; and providing psychosocial assistance. Additionally, nurses may be providing care at the scene of the event or at field hospitals established to administer supplemental care to the community.

Recovery

The focus of relief response efforts is the delivery of health care throughout the time of the community's immediate needs. Gradually, this phase will give way to the recovery phase of the disaster, with a decline in the number of patients in urgent need of care, and the arrival of outside resources to augment the healthcare capacity of the community. Recovery efforts are directed to rebuilding the

basic societal functions of the community, including rebuilding the healthcare system to ensure adequate mechanisms are in place to effectively provide and monitor the ongoing health needs of the community.

Disaster healthcare recovery plans should incorporate the long-term support provided by the nurses who care for the individual needs of the population. Post-response nursing tasks include public health surveillance, establishing temporary clinics, guiding immunization programs, and ensuring that the ongoing health and survival needs of the community are met. Healthcare facility nurses may be providing care in tents or other temporary shelters for an extended period of time, if their facility sustained significant structural damage. Nurses also may be involved in providing psychological care to the community to assist its members with the grieving and coping processes. Nurses' knowledge of the community, coupled with their flexibility in providing a broad range of needed tasks, underscores the need for their extensive involvement in the recovery efforts to return the community to a pre-disaster state.

CONCLUSION

During disasters, nurses will be called upon to provide aid and care utilizing their unique skills, abilities, and understanding of the community. Without the care provided by nurses, the community is likely not to fare well. To be effective, nurses must be prepared; this preparation includes education in relevant disaster topics, skills acquired through hands-on practice, interaction with preparedness procedures, and a firm understanding of local and regional capabilities and resources.

DISASTER NURSING ADAPTABILITY: AUSTRALIAN TEAM IN THE MALDIVES POST-TSUNAMI 2004

The ability to adapt is critical during disaster relief responses. Supplies may not be available and improvisation to devise substitutes for infrequently used or unusual items may be required. Members of the Australian Team's relief response to the Maldives following the tsunami became creative in finding alternative items for missing needed supplies. Some examples of their creativity include:

- Using the large, rigid containers used to transport medical supplies as privacy screens and walls between treatment areas in a temporary ED;
- Using polyvinylchloride (PVC) body bags to store and transport sterile consumables to keep them clean and dry in humid, tropical conditions;
- Using 350 milliliter plastic water bottles as spacers for multi-dose inhalers used in the treatment of salt-water pneumonitis; and
- Using rigid plastic drink bottles as sharps containers at each patient's bed area.

Jeffrey Williams

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CHAPTER 2

HEALTHCARE FACILITY PREPAREDNESS

Knox Andress

“PREPAREDNESS IS THE AGGREGATE of all measures and policies adopted before an event occurs that promotes mitigation of the damage caused by an event, and minimizes the dysfunction that could result from the damage. It consists of measures that a facility/community/country/region maintains, at a particular time, to combat the potential deleterious effects of local hazards. It includes the capacity to withstand a forthcoming event, to provide for effective emergency management, and to assist expedient recovery to the pre-event state.”¹

TRADITIONALLY, HOSPITALS HAVE lagged behind other public service providers in their level of disaster preparedness. Reasons for this include a lack of funding and a lack of understanding of the role of the hospital during a disaster. Simply put, the role of the hospital is to maintain operations through a disaster to properly care for the community’s health needs. Evidence demonstrates that hospital and health system disaster preparedness improves associated mortality rates. Relationships between the number of case fatalities and health sector preparedness were demonstrated in a study of four earthquakes: two in the US state of

OBJECTIVES:

- Describe the four phases of disaster management;
- Explain the different classifications of hospital vulnerabilities; and
- Understand the components of the hospital emergency operations plan.

California (Loma Prieta and Northridge), one in Kobe, Japan, and one in Armenia.² The two Californian health systems with high disaster preparedness indices had low fatality rates (67 deaths among the 3,824 injured in Loma Prieta, and 57 deaths among the 9,057 injuries in Northridge). In Kobe, Japan where health systems had mixed preparedness levels, there were 4,571 deaths among the 19,249 injuries within the city, and 5,480 deaths out of the 100,380 injured in the metropolitan area. And in Armenia, with a low disaster preparedness index, there were 25,000 deaths among the 40,000 injured.² While preventing an earthquake is not possible, reducing the mortality from an event is possible and equates to enhancing healthcare system preparedness.

Preparedness involves having the plans, supplies, and staff in place to respond in a timely and efficient manner during a disaster. Preparedness also requires the funding and executive-level support within the hospital as well as interagency support within the community to ensure implementation and cohesion of plans and processes. Additional challenges to disaster preparedness occur in developing plans for events that could compromise a hospital's functionality secondary to structural, non-structural, and organizational impacts. Hospitals may experience structural failure; lose infrastructure, supplies, staff, and equipment; and may be unable to accommodate a large influx or surge of patients. The 2003 Algerian earthquake rendered 50% of the hospitals and healthcare facilities in the impacted region non-functional, while the 2005 South Asia earthquake completely destroyed 49% of hospitals and health facilities in the most heavily affected region.³

Other challenges to preparedness are economic and management issues as hospitals and hospital systems are expected to provide disaster care, yet, often are not given the financial resources to accomplish this.

Despite all of these hurdles, hospitals play a critical role in community disaster response, making preparedness, resilience, and sustainability essential. In recognition of the vital contributions of healthcare facilities to the community, the World Health Organization (WHO) has proposed that governments, public health authorities, and hospital managers undertake necessary actions to ensure the safety of healthcare facilities during emergencies and disasters. In April 2009, the WHO celebrated World Health Day by directing attention to the large number of lives that could be saved during an emergency or disaster through improved design and construction of healthcare facilities, and through adequate preparation and training of healthcare staff.⁴

PREPAREDNESS PRINCIPLES

Hospital preparedness is a continuous, dynamic, and evolving process as identified threats and hazards change (e.g., a newly identified fault line beneath the hospital or a new chemical factory within the community), and

levels of preparedness fluctuate (e.g., staff turnover may result in a lack of individuals with disaster experience currently working in the emergency department). Evaluations of responses to disaster exercises or actual events also may identify necessary changes for improvement of disaster plans and processes.

Although hospitals must be prepared for a variety of disaster-causing events, most disasters place similar demands on hospitals. Because of these similarities, it is not necessary to develop totally separate plans and procedures for every different disaster imaginable. Thus, hospitals are encouraged to view disaster planning from an “all-hazards” approach; separate plans for different disasters can confuse staff and cause an unnecessary strain on budgets and storage capabilities. Preparedness plans should address the commonalities among the different types of disasters that could occur in that area. For example, a plane crash and a bomb blast both result in an influx of patients who are in need of triage and rapid interventions, even though the cause of their injuries is different. Thus, the core of the hospital disaster preparedness plan is common to all events, with supplements included for those events needing specific responses, e.g., an event requiring the addition of a decontamination team to the hospital’s disaster response.

Additionally, hospital planners should bear in mind that anticipating all of the possible problems encountered during a disaster response is impossible, and that plans can become quite complex and confusing to staff if they contain too many details. Nothing defeats the purpose of a plan more than having staff urgently flip through thick policy books to determine what to do in the midst of a disaster. “Keep it simple” is a defining statement of effective disaster planning.

DISASTER PLANNING PRIOR TO THE BAM EARTHQUAKE

In an unpublished survey of responders and victims involved in the 2003 earthquake in Bam, Iran, the following response shortfalls were identified:⁵

- Lack of plans for the provision of health services;
- Shortage of pre-established locations for providing medical services;
- Lack of coordination between responding groups;
- Lack of an adequate information system;
- Poor division of duties, and a mismatch between the skills and tasks undertaken by responders;
- Unnecessary duplication of some services, while others were overlooked; and
- Interference from outside responding groups and volunteers.

The participants of the study believed that effective disaster management planning prior to the earthquake could have prevented most of these problems from occurring. One participant noted:

“... If another earthquake occurs, I am greatly afraid that a lack of preparedness will prevail again, unless there is a directive as to where my place is. And what should I do? When do I get ready?

The time of disaster is not a good time for planning...”

Hamidreza Khankeh

PHASES OF DISASTER MANAGEMENT

Preparing for a disaster requires an understanding of the phases of a disaster. The Federal Emergency Management Agency disaster management continuum defines four primary components or phases of a disaster:⁶

1. *Preparedness phase* — includes the assessment of and planning for hospital hazards and vulnerabilities. Preparedness involves those actions taken to bolster a hospital's state of readiness in response to a disaster and includes activities such as developing plans, creating policies, training staff, purchasing identified supplies, and performing drills or exercises;
2. *Mitigation phase* — is similar to preparedness in that mitigation activities are undertaken to decrease the damage from an event. Mitigation efforts might include moving generators away from basements to areas that are less likely to flood, building waiting rooms without large glass windows that could shatter in high winds, and/or building a hospital according to seismic building codes to minimize earthquake damage;
3. *Relief response phase* — includes the actual relief response activities undertaken to save lives and prevent injuries during a disaster. It is during the relief response phase when plans generated in the preparedness phase are put into place and those actions previously taken to mitigate the effects and impacts of an event are appreciated. The relief response phase is dynamic and transitions into the recovery phase;
4. *Relief recovery phase* — includes those activities aimed at returning the affected population/community to its pre-event status. This phase may be long-term, based on the magnitude of the event.

Sundnes and Birnbaum identify a fifth phase of a disaster, the *Development phase*, which includes those activities aimed at improving the state of the affected society beyond its pre-event level.⁷ This phase is linked to the preparedness and mitigation phases using strategies based on lessons learned from the disaster, e.g., building more resilient structures that will be less vulnerable in a future event, developing improved warning and communication systems, and providing community education.

HOSPITAL VULNERABILITIES

Hospital vulnerabilities refer to the potential weaknesses and failures that a hospital might experience during an event. The understanding and the careful identification and assessment of potential hazards and vulnerabilities allow for effective planning and disaster risk management. Planning should focus

on those threats that are deemed likely for the given geographic location of the hospital.

Hazards are the potential threats that may occur during a given time period in a given place. Events can be caused by natural hazards (earthquakes, volcanoes, cyclones, etc.) or man-made hazards (hazardous material spills, industrial site explosions, transportation accidents, etc.), or a combination of the two.

Vulnerabilities are the identified points of weakness that an organization may have for a specific hazard. A hospital's vulnerabilities can be impacted by its level of preparedness. For example, the higher the hospital's level of preparedness for the possibility of flooding, the lower is its level of vulnerability to that event.

Risk is the probability of damage or loss of function that will occur given the hazardous event taking place, and the level of vulnerability to that particular hazard. The risk(s) to a facility is the product of both the hazard and the facility's vulnerabilities, minus the facility's capacity to cope with and/or minimize the functional changes.⁷ This can be expressed as:

$$\text{Risk (R)} = [\text{Hazard (H)} \times \text{Vulnerability (V)}] - \text{Capacity}$$

The ability of the facility to cope and to continue to function despite damage and a change in available resources (i.e., its *buffering capacity*) can be altered in order to reduce its risk(s).⁷ For example, while New York City may not be prepared specifically for a volcanic eruption (with a low risk of occurrence), it has become prepared for another terrorist attack (with a high probability of occurrence) by taking actions to correct identified points of prior weakness and vulnerability. Such preparedness activities not only have decreased New York City's vulnerability to a terrorist attack, but, by actively improving its buffering capacity, the city's level of vulnerability and, thus, its overall risk have been reduced.

In terms of healthcare facilities, vulnerabilities can be classified as external or internal. *External vulnerabilities* are vulnerabilities to those events that occur outside of the hospital, but that impact the hospital and its ability to provide health care. Examples of external events include war and geopolitical conflict, volcanoes, tsunamis, earthquakes, and hurricanes. The impact of these events on the hospital may be a rapid influx of a large number of patients, or limitations in services secondary to damage within the community that impairs access to the hospital by the staff and medical suppliers.

Internal vulnerabilities are vulnerabilities to events that impact or damage the hospital directly, such as building damage from a tornado, earthquake, fire, or flooding.

Hospital vulnerabilities also can be viewed as structural, non-structural, and administrative/organizational in nature:⁸

➤ *Structural vulnerability* includes weaknesses in the hospital

buildings or structural components that are required for physical support (e.g., foundations, supporting walls, beams, and columns). These components are subject to weakening and failure in a number of events, including floods, explosions, typhoons, hurricanes, and earthquakes;

- *Non-structural vulnerability* refers to the vulnerability of infrastructure components that are essential to the functionality of the building, including plumbing, heating, ventilation, air conditioning, information management/technology, water supply, and electrical power; and
- *Administrative/Organizational vulnerability* refers to the human resources and supply management that are necessary to maintain functioning of the hospital.

Assessing a Hospital's Vulnerabilities

The foundation of a hospital's preparedness and planning includes a hazard assessment or hazard-vulnerability analysis (HVA), which considers all identified potential threats to the hospital. The HVA is a component of the hospital emergency operations plan and must be re-evaluated regularly for new threat developments or hazard considerations. Probability and impact are the two main components of risk considered in the HVA.⁹ The hospital's HVA should be in concert with the community's HVA.

A thorough HVA of the hospital is conducted using the following steps:

1. Determine all the hazards that potentially could impact the hospital, either directly or indirectly. Utilize historical records, community hazard data, weather history, and flood maps, and consider every event that could cause a disruption in service (power outages, Internet down, water loss, etc.);
2. Determine the hazard occurrence probability. Rank the probability of occurrence by categorizing it as having a high, medium, low, or zero possibility of occurrence, and assign each ranking a number;
3. Determine the hospital's risk. Rank the impact upon the hospital taking into account the threats to: life, health, and safety; property damage; business viability; community trust; internal systems failures; and legal ramifications;
4. Determine the hospital's current preparedness level for each identified threat; and
5. Determine the priority of actions required to achieve preparedness, or obtain a higher level of preparedness for the identified, potential, damaging, and disruptive hazards.

Various techniques, models, and tools are available for calculating the

HVA; many are available on the Internet, through consulting firms and in other publications. The American Society of Healthcare Engineering of the American Hospital Association offers one method that considers potential natural, technological, and human threat events, and evaluates each for probability, risk, and preparedness by considering the following issues:¹⁰

1. Probability issues:
 - a. Known risk;
 - b. Historical data; and
 - c. Equipment manufacturer statistics.
2. Risk issues:
 - a. Threat to life and/or health;
 - b. Disruption of services;
 - c. Damage/failure possibilities;
 - d. Loss of community trust;
 - e. Financial impact; and
 - f. Legal concerns.
3. Preparedness issues:
 - a. Status of current plans;
 - b. Training/education status;
 - c. Insurance;
 - d. Availability of backup systems; and
 - e. Community resources.

With this tool, the probability, risk, and preparedness ratings are multiplied for each threat event. The total values, in descending order, represent the priority areas of organization focus and emergency resource planning. The method also determines a value at which no action is necessary, i.e., an acceptance of the level of determined risk.

Hospital Safety Index

The Hospital Safety Index (HSI), a product of the Pan-American Health Organization's (PAHO) Disaster Mitigation Advisory Group (DiMAG), assists hospitals in assessing their safety, prioritizing planning, and preventing facilities from becoming a casualty of a disaster.¹¹ The HSI provides an overview of the probability that the hospital will be able to function in a disaster or emergency situation. The tool incorporates a standardized Safe Hospitals Checklist for the evaluation of 145 areas within the hospital, taking into account structural, non-structural, and functional components of the hospital. An evaluation team's score of each area is entered into a computer with software that calculates results and ranks the hospital's ability to withstand an event and continue functionality. The final HSI score, which is calculated automatically, places the hospital into one of three categories:

Category A — facility is able to protect the life of its occupants and is likely to continue functioning during disaster situations;

Category B — facility can resist an event, but equipment and critical services are at risk; and

Category C — facility and the lives and safety of its occupants are at risk from an event.

This rapidly deployable assessment/diagnostic tool is available at: http://safehospitals.info/index.php?option=com_content&task=view&id=30&Itemid=103.

HOSPITAL PREPAREDNESS PLANNING

Hospitals must plan and prepare for managing the identified threats and hazards of the HVA and HSI in an organized and systematic manner considering potential facility impacts and resources needed to manage and recover from the event. Two primary hospital preparedness and management goals include providing a safe environment for patients and staff while, at the same time, responding effectively to the disaster. The hospital preparedness process includes: (1) developing hospital emergency preparedness policy; (2) planning responses for indicated emergencies or disasters; (3) training and educating staff; and (4) monitoring and evaluating outcomes.¹²

Emergency Operations Plan (EOP)

The hospital EOP, which contains the strategies for managing hospital disasters, provides the framework for emergency and disaster planning, education, exercises, and assists in increasing the hospital's disaster resilience. The EOP contains the written strategy for hospital disaster and emergency preparedness, response, mitigation, and recovery phases. EOPs utilize an "all-hazards" strategy that allows flexibility and scalability in the disaster response, and is based on the results of a hazard-vulnerability analysis or threat assessment.¹³ Components of the hospital EOP include:

- Planning and management;
- Personnel roles and responsibilities before, during, and after the disaster or emergency;
- Medical care provisions;
- Communications (internal and external);
- Logistical support;
- Finance;
- Equipment;
- Patient tracking;
- Fatality management;
- Decontamination;
- Plant, facility, and utility operations;

- Safety and security; and
- External agency coordination.

The preparedness process also includes the coordination of the response inside and outside the facility implementing an accepted incident command or management system, such as the Hospital Incident Command System (HICS).¹⁴

Response Components

The primary measures that hospitals need to undertake to improve their disaster preparedness capabilities generally are divided into the “three Ss:” *Staff*, *Stuff*, and *Structure*.¹⁵

Staff includes all personnel as well as all measures related to improving the human resources component of a disaster response. Such measures include: creating staff recall lists; creating staging areas for staff reporting back to work; changes in scheduling; changes in nurse-to-patient ratios; re-assignment of staff

ER ONE: THE NEXT GENERATION OF MITIGATION STRATEGIES FOR HOSPITAL EMERGENCY DEPARTMENTS

ER ONE is a unique care facility, located at Washington Hospital Center, Washington, DC. It is funded by the US Congress and designed as a prototype for all new emergency departments (EDs). Its unique design features are aimed at mitigating the impact on hospitals of conventional and non-conventional threats. Traditional ED designs are problematic for the proper response to terrorist events. Some of these problems include:

1. Inadequate surge capacity;
2. An unsafe environment from re-circulated air and surface contamination;
3. Inadequate arrival and departure area capacity;
4. Poor control of entry points;
5. Poor data availability;
6. Inadequate decontamination facilities;
7. Poor communications capabilities; and
8. Dependence on external utilities.

To address these issues, ER ONE has incorporated design principles that include:

1. Dual-use capability — features that have a role in day-to-day functioning as well as disaster operations;
2. Surge capacity/scalability — capability of handling large patient surges without stockpiling rarely-used equipment;
3. Modularity/flexibility — system designs that allow functions to be altered easily based on current needs;
4. Familiarity — tasks and equipment approximate staff's daily routine; and
5. Knowledge management — pertinent, functional knowledge/information built into systems or facility design to aid staff in determining appropriate action/intervention.

Susan Eckert

to areas other than their primary unit; providing meals and sleep areas for staff during long-term events; and assigning specific duties related to the response.

Stuff refers to the materials required to provide for the care of the disaster victims. This includes needed medical equipment, medications, and supplies. These materials may be used in everyday care; additional or supplemental materials may be stockpiled solely for a disaster event. Most hospitals keep specific levels of stock, i.e., baseline levels, or “just-in-time” inventory on hand. Increasing these levels to allow for a larger amount of supplies on hand that rotate through normal hospital usage tends to work better than maintaining a separate stockpile that isn’t utilized except during a disaster. Separate, unused stockpiles tend to contain expired materials, missing materials, and uncertain materials when finally needed. Specific supplies to have on hand include: ventilators; particle filter masks; decontamination equipment; medications specific to a disaster situation, such as ciprofloxacin or doxycycline; triage and patient tracking items; and “soft goods”, such as bandaging supplies.

Structure consists of both tangible and non-tangible structure. Tangible (physical) items include: (1) the construction of decontamination facilities; (2) additions to hospital buildings, such as stand-alone facilities created for screening centers during a pandemic; (3) electronic equipment capable of “locking down” entrances to the hospital; and (4) redesign of the ED for better patient flow in a high-volume disaster situation. Non-tangible structure refers to those items that lend structure to the response through the organization of available resources, such as the hospital’s Incident Command System and the EOP.

EDUCATION, TRAINING, AND EXERCISES

There are many types of education and training that must be provided to the hospital staff to prepare them to respond effectively to a disaster. Education and training can be of a general nature, yet specific to a certain facility or agency; ideally, both aspects are combined in training. General education and training topics include:

- Terrorism and weapons of mass destruction;
- Hazardous materials;
- Decontamination; and
- Hospital incident command.

These topics provide a foundation of knowledge that can be linked to the processes and plans of a specific facility. For example, decontamination training provides knowledge as well as experience in the use of available personal protection equipment that are linked to education on when and how to implement the hospital’s decontamination plan. Specific education and training would include: (1) when to establish incident command; (2) when and how to begin a disaster response; (3) how and where disaster triage is performed; (4) what areas are set up to receive triaged patients; (5) how to use the hospital’s decontamination system; and (6) where to set up the decontamination zone.

Distinct challenges in providing education and training include the lack of educational standards and universally accepted competencies. Thus, determining if people have been educated and trained to an appropriate level, and ensuring that all staff are appropriately prepared for their level of responsibility within the organization are problematic. For those hospitals attempting to receive US government grant money, the US Hospital Preparedness Program mandates staff education and training in the National Incident Management System (NIMS), and the incident command system. Yet, there are no standards for determining the effectiveness of the classes offered.

Exercises and drills are used to test the hospital system and the performance of individuals during a simulated disaster. In turn, the post-drill evaluation process can be useful in identifying overlooked educational topics or individuals. Exercises and drills may be planned and announced, or may be a surprise to all but the planners. Drills may consist of:

- *Computer simulations* that present a disaster scenario to individuals or groups of participants who respond to the situation through interactions with a computer program. The simulation allows staff to gain an understanding of their specific roles and responsibilities, and practice in making the types of decisions they will need to make during real events;
- *Tabletop drills* consist of the presentation of disaster scenarios to key individuals who work together as a group to respond to the scenario as if it were a real event, but within the confines of the meeting room. These drills provide staff an understanding of their roles and interactions with other members of the incident command structure; and
- *Operational or mock drills* consist of enacted events with volunteers acting as victims (with or without moulage) or with the use of paper-based victims (i.e., cards describing specific victim injuries in place of actual persons) and staff responding appropriately.

Drills may be conducted on various levels within a facility. They may involve one or two isolated departments (such as the ED), or they may be full-scale exercises involving the entire facility. A community drill may involve outside agencies or it may involve only local resources, such as emergency medical services and the fire department. Within a region, drills may involve other hospitals with all area hospitals receiving simulated patients, or they may involve only one hospital in an evacuation simulation with dispersal of all of its patients to the other hospitals in the area. Regional drills also may involve state and federal entities.

Drills should be tied to specific components within the Emergency Operations Plan that the organization wishes to evaluate. These evaluated components may be very specific, such as wanting to determine the amount of time needed to establish a decontamination shower, to more global issues, such as

evaluating the flow of information during a disaster. Evaluation is accomplished by assigning observers to assess specific components of the drill. The Johns Hopkins University's Evidence-based Practice Center recommends that the following four components of drills or exercises be evaluated:¹⁶

- Incident Command;
- Decontamination;
- Triage; and
- Treatment.

Although there are some differences in the assessment points within the different areas, evaluators must assess the following aspects in each of the areas:¹⁶

- Command structure;
- Adequacy of staffing and physical space;
- Communication and information flow;
- Security and victim and staff safety;
- Victim flow; and
- Adequacy of materials.

After a drill, evaluators discuss the drill with the participants (either all participants or key members from each area) in a debriefing or a "hotwash" session, for

ISRAELI USE OF AFTER ACTION REVIEWS (AARs)

The implementation of After Action Reviews (AARs) immediately following a mass-casualty incident or drill importantly contributes to the effective management of future events and the provision of a high quality of care to casualties. In order to enable all medical organizations to perform AARs in a professional and optimal manner, the Israeli Ministry of Health (MOH) has developed a structured protocol and methodology for their conduct. The tool identifies the following stages of an MCI to be reviewed:

1. Organization and preparation;
2. Admission of casualties;
3. Treatment; and
4. Return to routine operation.

The tool also identifies: (1) which participants/spokespeople must attend the AAR; (2) the elements that should be reviewed; and (3) guidelines for the director responsible for leading the AAR. Three levels of AAR are utilized:

1. A debriefing conducted in each department of the hospital immediately after the event;
2. An AAR conducted within 48 hours of the event, in which representatives from all departments involved in the MCI participate; and
3. A concluding meeting held within one to two weeks following the incident for all of the departments and units involved in the MCI.

The conclusions drawn from the AAR are distributed to all hospitals by the MOH.

Bruria Adini

the purpose of obtaining further performance data, both good and bad. The intent is to gather information for improvement, not to find fault with specific individuals who may not have performed well. Based on the debriefing information gathered and the evaluators' reports, an AAR is compiled detailing shortcomings of the drill and corrective actions that must be taken to correct those issues.

HOSPITAL PREPAREDNESS INITIATIVES

The ability of hospitals to improve their preparedness capability and to protect the lives of patients and healthcare workers often is linked to national and international planning initiatives and guidance. Examples of international and national hospital preparedness initiatives and programs include: (1) Hospitals Safe from Disaster; (2) India's GoI-UNDP Disaster Management Program; and (3) the US Hospital Preparedness Program. Other preparedness capabilities may be related to the requirements of one of the following national or state regulatory groups:

Safe and Resilient Hospitals

The occurrence of catastrophic events can impact communities and hospitals negatively in both developing and industrialized countries. Many times, hospitals and healthcare facilities are not able to function during a disaster — the time when they are most needed. Examples of events that highlight the importance of hospital survival during and after catastrophes include the 26 January 2001 earthquake in Gujarat, India, which devastated 227 healthcare facilities, and the Southeast Asia earthquake and tsunami in 2004 that destroyed 42 hospitals and 195 healthcare facilities or clinics in the impacted region.¹⁷ Not only is the immediate medical response impacted, but community healthcare services may not be restored for months or even years after the disaster.¹⁸

Within the last 10 years, a number of global conferences and forums sponsored by the United Nations/International Strategy for Disaster Reduction (ISDR), the Joint Commission International (JCI), and the World Association for Disaster and Emergency Medicine (WADEM) have presented information and discussions regarding the importance and need for hospital disaster risk and vulnerability reduction. Forums have addressed the need for guidelines for designing, constructing, and evaluating “safe and resilient” hospitals. In support of this issue, the ISDR has adopted the Pan American Health Organization/World Health Organization's “Safe and Resilient Hospital” initiative. Ensuring physical and functional capability and integrity during and after disaster are the primary foci of this initiative.¹⁹

GoI-UNDP Disaster Management Program

Under the direction of the United Nations, the GoI-UNDP Disaster Risk Management Program is a national initiative that seeks to reduce the vulnerabil-

ities to a disaster due to an earthquake in 17 states and 169 districts within India.²⁰ Its “Guidelines for Developing a Hospital Emergency Management Plan” in-tends to support and assist hospitals in formulating their own all-hazards emergency response plan in accordance with their available human and material resources. The guidelines provide a hospital emergency response plan that could be integrated into existing community response planning to strengthen overall community coordination during a disaster.

Hospital Preparedness Program (HPP)

Established by the United States Department of Health and Human Services (HHS) in 2002, the Hospital Preparedness Program (HPP) aims to enhance the ability of hospitals and healthcare systems to prepare for and respond to bioterror attacks as well as other public health emergencies, such as a pandemic and other disasters.²¹ Past Hospital Preparedness Program priorities have included: (1) increasing hospital bed and personnel surge capacity; (2) expanding decontamination capabilities; (3) isolation capacity; (4) pharmaceutical supplies; (5) training; (6) education; and (7) drills and exercises. Current priorities for hospitals and healthcare systems include: (1) improving hospital disaster response capabilities in areas of interoperable communication systems; (2) bed tracking; (3) personnel management; (4) fatality management planning; and (5) hospital evacuation planning.

CONCLUSION

Healthcare organizations are challenged to respond to emergencies and disasters occurring from a variety of local, regional, national, and global hazards. Hazards can arise internally or externally to the healthcare facility; those compromising the hospital directly require additional preparedness plans. With the responsibility of providing health care to the community, healthcare facilities play a critical role in community disaster response and recovery, and must strive, through appropriate preparedness and mitigation activities, to remain safe, resilient, and functional.

Disaster preparedness involves all measures and policies undertaken to reduce the amount of damage that could occur from an event.¹ This includes having written and rehearsed plans, necessary supplies, and staff in place to respond to a disaster in a timely and efficient manner. Proper preparedness also requires funding and executive-level support within the hospital, as well as interagency support within the community to ensure implementation and cohesion of disaster management plans and processes. The state of preparedness is not static, but rather is dynamic, incorporating updated knowledge and procedures, newly identified threats, and the correction of areas of weakness that have been identified in drills or actual events.

As integral members of a hospital's healthcare team, nurses play a vital role in hospital disaster preparedness. Activities in which the nurse, individually or as a member of his/her national or international nursing association, may engage to improve hospital disaster preparedness include:²²

1. Becoming familiar with and raising public awareness of those natural events that his/her institution/region/country are most likely to experience;
2. Being informed of diseases and social behaviors associated with disasters and deteriorated living conditions;
3. Being aware of associated physical and mental health, socio-economic, and nursing needs of potential disaster victims;
4. Lobbying institutions and governments to prepare for disasters by assessing potential hazards and vulnerabilities;
5. Actively participating in his/her hospital's and/or community's disaster planning to ensure nursing input;
6. Supporting the development of an accountable chain of command within relief organizations and measures to facilitate access to goods and services;
7. Urging the development and implementation of relevant policies, procedures, and necessary legislation;
8. Participating in the education and training of nursing staff to be effective in a crisis/emergency situation;
9. Incorporating disaster preparedness awareness in educational programs and obtaining and/or providing continuing education to ensure a sound knowledge base, skill development, and ethical framework for practice; and
10. Networking with other professional disciplines, governmental, and non-governmental agencies at local, regional, national, and international levels.

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CHAPTER 3

COMMUNITY BEHAVIOR AND RESPONSE TO DISASTER

Tricia Wachtendorf,^a James M. Kendra,^a and Brandi Lea

ON 11 SEPTEMBER 2001, while the first formal emergency responders were trying to cope with the devastation caused by the attacks on the World Trade Center in New York City, an important — but rarely discussed — response activity was underway. In addition to the many people who evacuated Lower Manhattan by walking uptown or across the Brooklyn Bridge, an estimated 300,000 to 1,000,000 commuters and area residents were evacuated via an emergent flotilla of harbor vessels, including ferry boats, dinner cruise vessels, harbor tugs, and private watercraft. Some vessel captains followed directions issued by the US Coast Guard, whose officers had issued a call for all available boats to provide assistance. Other vessels converged to the site prior to, or without having heard, the Coast Guard call, and many acted independently and according to their best judgment, rather than under agency or harbor pilot direction. Quickly, a landward support network developed along the waterfront, with individuals taking steps to facilitate the embarking and dis-

OBJECTIVES:

- Understand the six steps of the warning process model;
- Discuss the four types of organizational behavior in disasters; and
- Describe convergence behavior and its benefit to the disaster response.

a. Tricia Wachtendorf and James Kendra are principal investigators on a project studying improvisation and organizational responses during waterborne evacuation. Unpublished findings from this study are drawn upon to illustrate several points throughout the chapter. The following sources of funding have contributed to this study: Multidisciplinary Center for Earthquake Engineering Research (MCEER) New Technologies in Emergency Management, No. 00-10-81 and Measures of Resilience No. 99-32-01; the National Science Foundation; the Public Entity Risk Institute No. 2001-70 (Kathleen Tierney, Principal Investigator); National Science Foundation No. 0603561 and 0510188 (James Kendra and Tricia Wachtendorf, Principal Investigators); and the University of Delaware Research Foundation (Tricia Wachtendorf, Principal Investigator). We are grateful to the South Street Seaport Museum (Mr. Jeffrey Remling, Collections Director) for access to interviews with participants in the waterborne operations. Funding to the museum for these interviews was provided by the National Endowment for the Humanities; and the interviews were conducted by David Tarnow. The views expressed here are those of the authors and do not necessarily represent those of funding agencies.

embarking of evacuees (either by providing direction, forming queues of evacuees, or removing barriers); providing basic first aid; transporting evacuees after they reached the waterfronts of New Jersey, Brooklyn, or Staten Island; or managing supplies, equipment, and emergency personnel to be transported back to the event site (Ground Zero). Although no pre-existing plan outlined the way in which this activity evolved, the waterborne evacuation was improvised successfully and illustrates the important role that citizens and non-governmental organizations play in emergency evacuations and disaster response efforts.

COMMUNITY EVACUATION BEHAVIOR^b

Evacuating people from a threatened area is one of the principal strategies used to protect lives. While there certainly are situations in which evacuation is not appropriate, as in tornados or incidents involving certain hazardous materials where sheltering-in-place is the better option, evacuation remains an important emergency response function. Evacuation can begin spontaneously if people perceive danger or if an emergency suddenly occurs, or evacuation may occur in advance of an impending event based on official recommendations or orders. But, whether spontaneous or directed, evacuation behavior is tied closely to people's understanding of their environment, their individual capacities and social relationships, and their comprehension of the threat to their life. In other words, as with other disaster-related activities, evacuation typically is a socially-mediated activity,¹ which means that it relies heavily on existing or emerging social networks.

Much evidence has accumulated showing that people do not begin the evacuation process immediately upon being directed to do so. Rather, they engage in a number of well-defined behaviors that have been demonstrated in many different crisis situations.¹⁻⁴ Receiving a warning to evacuate marks the beginning rather than the end of the warning process. People do not simply hear the message and take action. The *warning process model* contends that upon receiving a message, recipients experience six stages in which they: (1) hear the message (or read it); (2) evaluate and comprehend it; (3) believe it (i.e., assess its trustworthiness); (4) personalize it (i.e., realize that the warning is *for them* and that they are in danger); (5) decide what to do; and then (6) act.⁴⁻⁷ People are not likely to take action without surveying the environment for definitive signs of danger — such as threatening clouds or increasing winds — and will “confirm” the message with family, friends, or other sources.

Evacuation behavior is a group activity; people tend to leave a threatened area with the people who are closest to them. Families will evacuate before an oncoming storm in intact units whenever possible, and employees tend to leave threatened workspaces with their colleagues and office mates. In fact, people

b. This section principally addresses community-wide evacuations as opposed to the evacuation of buildings or other discrete facilities.

often will delay their own evacuation to ensure that those they are closest to will evacuate as well.^{2,3} This phenomenon belies the idea of panic, or that people are overcome with fear to the extent that it dominates their thinking and actions. A considerable body of research shows that widespread panic, popularly expected when people are exposed to danger, is a myth, and that, instead, people tend to be helpful and pro-social, except, perhaps, when there is a perception of immediate and severe danger, the closing of the time window for escape is imminent, and/or there is a lack of communication about the situation.^{8,9} In all the disaster literature, this evidence of group activity has been among the most durable principles of human behavior.¹

In the World Trade Center attack of 2001, for example, evacuation from the towers was orderly; people helped each other, sometimes at risk to their own lives.¹⁰ That behavior continued during the waterborne rescue operation; people stood in line, waited their turn, and helped each other. Certainly, people may describe themselves as having felt “panicky”, but what they mean is that they



Figure 3.1: New York City, 11 September — Coast Guard crew members patrol the harbor after the collapse of the World Trade Center. Terrorists hijacked four commercial jets and crashed them into the World Trade Center in New York City, the Pentagon in Washington, DC, and the Pennsylvania countryside.

were under stress, couldn't think clearly, or didn't know what to do. Fear is a reasonable response to terrifying situations, but it is not the same as panic. Panic, in a sociological sense, has been described as dysfunctional escape behavior¹¹ or the "collective flight based on a hysterical belief".¹² Instead, most people act with consideration and helpfulness, and panic is rare. In other words, how people describe their feelings is very different from the actions they undertake. Emergency officials may believe that it is necessary to withhold information from citizens in order to avoid panic. However, this concern is unfounded; people exposed to danger want information.^{10,13} Tierney noted that people in the Twin Towers in New York City, although certainly frightened, made phone calls, sought guidance from family and friends, watched television, and tried to make sense of their situation.¹⁰ A careful examination of photographs as well as documentary and news footage of the people fleeing the collapse of the towers through the streets of New York City, indeed, may show fear, but it does not show panic.

Evacuation is a social activity that is grounded in people's social experiences. One consequence of the social phenomenon of evacuation is that people's behavior will vary based on their particular circumstances. Not everyone evacuates the same way or at the same time because of factors such as varying

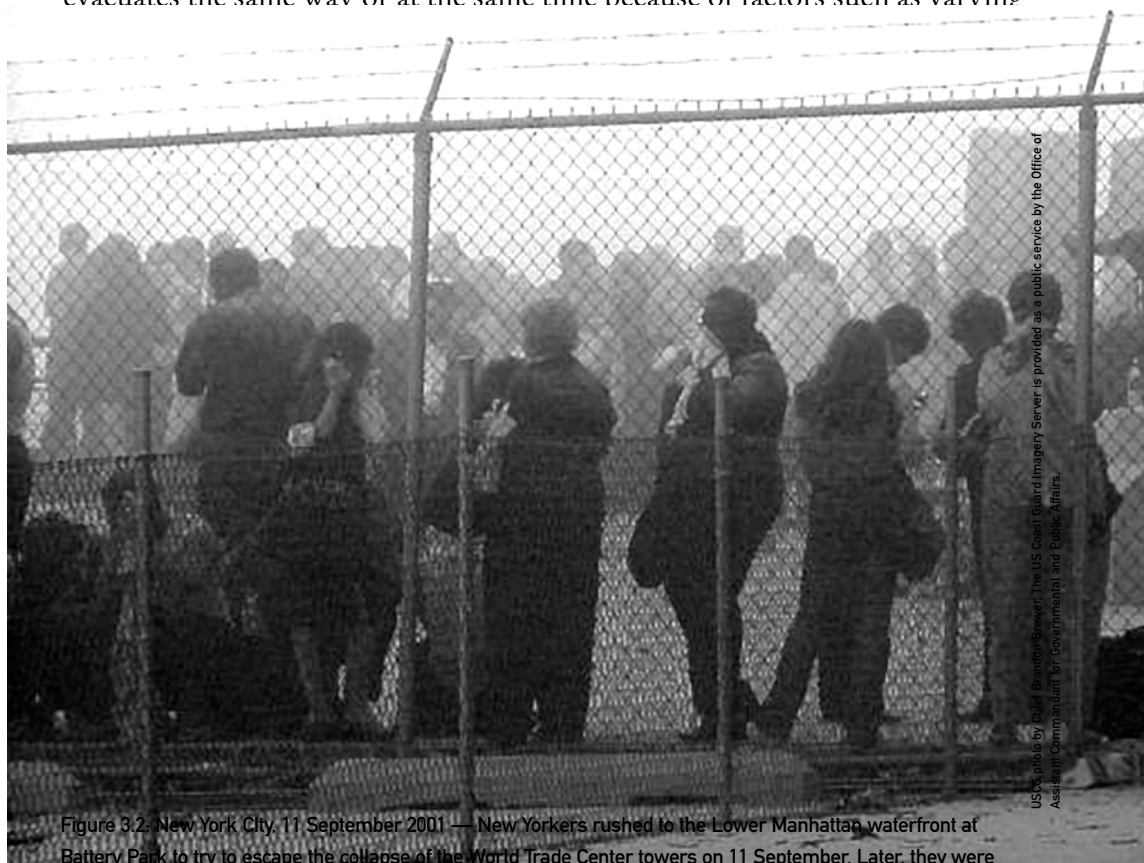


Figure 3.2: New York City, 11 September 2001 — New Yorkers rushed to the Lower Manhattan waterfront at Battery Park to try to escape the collapse of the World Trade Center towers on 11 September. Later, they were evacuated by ferries and tugboats from all over New York harbor.

USPS photo by David Brundage-Brewer. The US Coast Guard Imagery Server is provided as a public service by the Office of Assistant Commandant for Governmental and Public Affairs.

or demographic characteristics. For example, households with children, as well as households with women, are more likely to evacuate than those without women or children.^{14–16} Others may fail to evacuate because they are institutionalized, lack mobility, or have failed to hear the warning because of ability, language, or their lack of connection to the community (such as transients or tourists).¹⁷ Others may remain behind to help those unable to leave.

While persuading some people to evacuate can pose a significant challenge, sometimes *more* people evacuate than should do so. This is termed *evacuation shadow* and refers to the evacuation of people outside of the recommended area of mandatory evacuation. One reason for this occurrence is that people may interpret their area to be at greater risk than officials do, and decide to leave anyway; or they may misunderstand where they are in relation to the area that officials want to evacuate.^{4,18} This *evacuation shadow* phenomenon occurred in Texas in advance of Hurricane Rita in 2005, when hundreds of thousands of coastal Texas residents left their homes for inland destinations. This mass exodus overwhelmed the highways causing trips that normally would take only a few hours to take a full day or more. Cars broke down or ran out of fuel along the way, further slowing vehicular movement. One expert on warning and evacuation suggests that some people anticipated the extreme conditions in New Orleans just a few weeks prior to Hurricane Katrina, and elected to leave rather than risk being stranded in their homes or shelters.¹⁹ The *evacuation shadow* can present management officials with challenges that are as serious as those encountered when people don't evacuate, since it means that many more people than expected will be traveling. More significantly, people who aren't in danger can slow the escape of people who are imperiled, and if the evacuation isn't complete before danger strikes, *all* might be caught in exposed locations.

Evacuation remains a social activity, whether it occurs spontaneously or through official channels preceding a disaster. Warning messages and information about evacuations must be specific and clear regarding the nature of the danger and the actions to be taken.^{4–7} The prevalent misconception about panic may lead to excess planning for behaviors that are exceedingly rare. It is important to remember that people will leave in groups (family or friends); families will not leave if all members (e.g., elderly, infirm members) are not able to evacuate; families with children will evacuate more readily than those without; and people will continue their pre-existing social network, as much as possible, throughout a disaster.

Informal Responses

Organizational behaviors in a disaster can be categorized into four types based on how they are structured and their responsibilities.^{20,21} *Established organizations*, such as fire departments, engage in routine tasks and maintain their pre-

disaster structure. *Expanding organizations*, such as the American Red Cross, engage in routine tasks, but adopt an alternate structure, such as expanding its structure to increase its numbers of volunteers, during a disaster. *Extending organizations* maintain the same structure that they had in place before the disaster, but take on non-routine activities (e.g., construction companies may become involved with clearing debris during search and rescue efforts). Finally, *emergent organizations* are organizations that did not exist before the disaster and, therefore, have new structures and engage in new tasks such as spontaneously formed search and rescue groups, and family assistance groups.

Established first responders, such as fire and police departments, play critical and obvious roles in a disaster response. However, the earliest responders to an event typically are neighbors, co-workers, surrounding businesses, and community-based groups closest to the disaster site. Although these individuals constitute emergent organizations, they also are expanding and extending organizations. Indeed, disasters typically lead to the creation of new or spontaneous social phenomena, or what often is referred to as *collective behavior*.^{22,23} This behavior is related to how groups operate and is organized prior to the event that becomes transcended, opposed, or modified through a joint effort of those involved in an event.²⁴

While the formal first responders provide assistance in disaster-impacted areas, they frequently must interact with other governmental agencies, the private sector, non-profit organizations, and individual citizens acting independently or as part of a collectivity. Some of these entities are part of an established emergency response organizational network.²⁵ Agencies and businesses may have set responsibilities assigned to them in the case of a disaster; their employees may have participated in disaster planning drills, and may even have a position allocated as a representative of their organization at the Emergency Operations Center. Expanding organizations — for example, the Salvation Army — may have strong networks and well-defined roles; others, however, may not have participated in pre-event planning and exercises, and thus, will be new to this network.

Aguirre *et al* studied search and rescue groups that emerged following the gas explosion in Guadalajara, Mexico.²⁶ Consistent with past research,²⁷ they found that these emergent groups were important in life-saving activities — particularly in the “golden” first hour of the disaster, before formal search and rescue teams arrive. They also found that coordination between volunteers and search and rescue professionals can prove difficult as conflict ensues over rescue strategies, ambiguous authority relationships, and relationships between independent agencies. Similar efforts were observed after the devastation of Hurricane Katrina; local citizens in New Orleans frequently were best suited to identify where an elderly neighbor who had refused or been unable to evacuate was stranded. While formal agencies, such as the US Coast Guard, had access to helicopters and personnel, and were essential in rescue efforts, so, too, were the citizens and

businesses from nearby areas using boats that were not destroyed in the hurricane. These civilians served as important auxiliary support for search and rescue activities of thousands of people stranded in the city, joining expanding search and rescue activities, or extending their own groups to participate in this new role. In other words, rescue operations relied on multi-organizational efforts involving a range of participants who converged upon the disaster site. The informal responders offered *human capital* (skills, knowledge, and experience), *physical capital* (tools and material resources, such as boats), and *social capital* (the norms and networks that facilitate collective action).^c Together, these various organizations, along with those individuals who operated alongside them, develop into what Drabek³⁵ terms an emergent multi-organizational network that must, for a limited time, work to address the emerging response needs.

Convergence and Informal Responders as Helpers

Convergence behavior, in the context of a disaster, involves the movement of people, materials, and information to a particular point associated with the event.³⁶ Among the people who converge in a disaster are: (1) helpers (formal and informal) attempting to provide assistance; (2) returnees, or those residents and employees who initially evacuated the area; (3) anxious family and friends seeking information about loved ones; (4) curious onlookers attempting to view the impacted area or relevant facilities; and (5) exploiters seeking to take advantage of the circumstances. The impact site is not the only area of interest to these convergers; i.e., they vie for access in a variety of areas associated with the response environment.³⁷ For example, hospitals, checkpoints, staging areas, warehouses, and other response-related facilities that may be located outside the impact zone. When people converge to the most devastated areas, it is because those sites have relevance to the response environment. At the same time, other facilities not in the most devastated areas may hold similar relevance and also attract convergers.

Informal helpers may assist response efforts because of their proximity to the disaster zone, familiarity with the site or the victims, flexibility to function outside bureaucratic mechanisms, and/or ability to provide needed skills when a gap in response capacity exists. At the same time, their involvement in the emergency response system can add complexity and confusion to a multi-organizational response. It can be challenging to identify those volunteers that possess useful skills from other well-intentioned volunteers who are less able to contribute to an effective response, particularly while emergency managers are occupied fulfilling their own response obligations. New volunteers often must be credentialed if they are to remain active within a response, may have limited liability or health compensation coverage for their work, and may be unfamiliar

c. Although social capital is often discussed with respect to economic growth, others have examined the concept examining a range of social problems.^{28–34}

with important information relevant to the response.^{1,33,37,38} They also may require food, shelter, first aid, and sanitary facilities, among other needs, thereby generating additional resource demands and management activities.

Consider, again, the waterborne evacuation of Lower Manhattan. Responding vessels already were within the harbor, many were *en route* to or from the impacted area. Most of the captains, mates, and deckhands were familiar with the harbor, and the waterfront's infrastructure; many also were familiar with the commuters who became the evacuees. Without an established plan to evacuate hundreds of thousands of people by boat, and with bridges and trains closed to traffic, the waterborne evacuation filled an important response gap. The participation of the harbor vessels also facilitated other informal and formal helpers as the boats transported converging personnel and supplies back to Ground Zero on return trips. Still, some well-intentioned individuals operated vessels that were less suited to a swift and safe response. Captains sometimes needed to negotiate their vessels within a heightened security environment and validate their response actions as they encountered government officials. Some individuals who assisted on the boats were not seamen or previously known to captains, mates, and deckhands. Rather, they were passers-by who were asked to help a short-handed crew. Their roles were instrumental; however, they were not credentialed and some had never before helped to operate a boat.

Preplanning for Informal Response

Several initiatives have been developed to integrate non-formal, unsolicited first responders into disaster responses. One example is the Medical Reserve Corps (MRC) program, which was started in 2002. Under the oversight of the US Office of the Surgeon General, the MRC program encourages communities to engage and train potential volunteers such as retired healthcare professionals, medical and nursing students, chiropractors, pharmacists, and dentists in training in their planning for the provision of disaster surge capacity. While these volunteers may or may not be skilled or credentialed to perform the same activities as usual healthcare providers, they can serve as a well-informed cadre of volunteers better suited than the average citizen to provide assistance to the formal healthcare responders. Other initiatives that have fostered community-based disaster approaches over the past decade include the Citizen Corps (focusing on homeland security and emergency response), Community Emergency Response Teams (focusing on training citizens in disaster response), and Project Impact (focusing on public/private, community-based disaster mitigation).^d In addition to the genuine contributions these participants can make to community disaster resilience, valuable by-products of

d. Project Impact, introduced by the US Federal Emergency Management Agency during the Clinton Administration, was terminated at the federal level during the Bush Administration; however, some communities that participated in the initiative have continued the program at the local level.

these programs are the relationships and familiarity that community groups develop with one another and with the emergency management community. At the same time, it is important to remember that spontaneous convergence still will occur, bringing with it valuable resources to meet unanticipated needs as well as the coordination challenges that plague complex disaster responses.

CONCLUSION

Definitions of a disaster generally refer to a situation in which community resources are overwhelmed and outside assistance is required.^{8,39,40} With the disruption of social structure and physical resources, informal responders have an important role to play in an effective disaster response. According to Shibutani, “if the normative framework does not provide an adequate guide to concerted action, the people involved in the situation must work together to improvise some way of coping with it.”⁴¹ By beginning dialogue with community groups and local citizens before a disaster develops, public officials with roles in emergency management may be able to identify and integrate citizen response as well as improve their ability to recognize the range of resources within a community when improvisation becomes necessary. Whether such planning is performed or not, spontaneous informal responders will converge to a disaster area; their presence is best dealt with in such a way that considers and reconciles the potential benefits and challenges they bring to the response. Similarly, formal warning and evacuation procedures are important in orchestrating evacuations; however, people rely on a variety of cues in their physical environment when engaging in evacuation behavior, and their activities are imbedded in the collective actions of their social network and those in close proximity to them. A stronger understanding by those in leadership roles of the ways in which existing and emergent mechanisms facilitate or impede effective community evacuation can bolster the community’s overall resilience to a disaster.

SELF-EVACUATION FROM TOKYO SUBWAY STATIONS

One hundred and thirty-one ambulances were dispatched to the 15 affected subway stations immediately following the 1995 sarin attack in Tokyo, Japan. Ambulances transported 688 victims, while more than 4,000 other victims walked or used different means of transportation, such as taxis and private vehicles, to reach nearby hospitals. At St. Luke’s Hospital, 25% of the victims that presented to the hospital’s emergency department were delivered by taxi, and two patients in cardiac arrest were delivered by private vehicle.⁴²

Robert Powers

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CHAPTER 4

FIRST RESPONDERS

Dario Gonzalez

LOCAL RESOURCES, such as ambulance and fire services, as well as specialized teams, are the first organized responders to arrive at a disaster site. After the immediate actions provided by the citizens of the affected area, the first responders provide the initial medical care to the victims. First-responder tasks include removing the victims from exposure to any hazardous materials or collapsed structures, prioritizing those victims that are in need of medical care, and transporting them to appropriate healthcare facilities. Depending on the magnitude of the disaster, and despite their sometimes Herculean efforts to manage the scene, these services quickly can become overwhelmed and depleted. Local emergency management officials also assist by providing oversight to ensure coordination and distribution of available local assets.

OBJECTIVES:

- Understand the goals of emergency medical services activities at the disaster scene;
- Discuss the roles of the various first-responder agencies and teams;
- Describe the five key pieces of information for the hospital nurse to obtain from the field; and
- Discuss local emergency management's disaster role, including its relation to health care.

Hospital staff require a clear understanding of prehospital operations to ensure that their actions complement field activities. Also, in a disaster setting, victims may self-present in mass to the hospital with minimal or no field assessments or interventions. Nurses may respond to a disaster site to augment emergency medical services resources and may provide the first and, for a period of time, the only medical care that the victims receive; in this setting, basic knowledge of prehospital operations and incident operations is critical. Furthermore,

if the hospital becomes damaged during the event, the nursing staff may need to lead or coordinate directly with field agencies in triage, assessment, evaluation and evacuation of victims and staff.

EMERGENCY MEDICAL SERVICES

Ambulance services, called emergency medical services (EMS) in many parts of the world, are responsible for the initial care of victims at the scene of an event and their transport to healthcare facilities. There is considerable variability among these services; they may be affiliated with community fire services or government entities, or they may be operated as private businesses. The EMS staff may include various healthcare providers (physicians, nurses, paramedics, or emergency technicians) with different skill sets; and they may be paid employees or volunteer staff. These trained healthcare providers can arrive on the scene by a variety of methods, including ambulance, fast response car, bicycle, moped, helicopter, fire engine, or even on foot.

The core role of EMS in the prehospital phase of patient care management includes four basic functions:

1. Prevention of additional injuries;
2. Rapid transportation of the victims to the hospital (this does not necessarily mean rapid treatment; delivery to the definitive care setting is preferable);
3. Advance notification to the receiving hospital; and
4. Triage and emergency treatment (necessary life-saving and/or stabilizing care).

EMS prehospital personnel are known by a wide array of titles throughout the world. Basic care providers are known as Emergency Medical Technicians (EMTs) in the United States, as Emergency Medical Responders (EMRs) in Canada, as *Rettungshelfers* (RH) in Germany, and as Ambulance Officers in Australia. Advanced care skills generally are provided by paramedics, although some countries, such as Canada and Australia, have different levels of paramedics, and in countries such as Germany and France, physicians or nurses routinely provide advanced care in the ambulance setting. Specialized care, such as administering thrombolytic drugs, is within the skill set of South Africa's Emergency Care Practitioner, and the United Kingdom's similarly titled provider can perform minor surgical procedures in the field. Typically, first responders are fire personnel with limited basic care training.

Regardless of the particular title, ambulance systems are based on the established skill levels of the accompanying staff. The differentiation of these skill sets usually is based on advanced skills, i.e., Advanced Life Support (ALS), vs. Basic Life Support (BLS). These skill sets are compared in Table 4.1.

SKILL	BASIC		ADVANCED
	Fire Responder	Ambulance Staff	
Airway management	Non-invasive method (bag-valve-mask)	Non-invasive method (bag-valve-mask)	Endotracheal/nasal intubation, needle tracheostomy, drug-assisted intubation (Etomidate), chest needle decompression for tension pneumothorax), CPAP
Intravenous access	No intravenous access	No intravenous access	Intravenous cannulation, saline lock, intraosseous infusion
Defibrillation and cardiac monitoring	Automatic External Defibrillator (AED), no rhythm monitoring or assessment	Automatic External Defibrillator (AED), no rhythm monitoring or assessment	Manual defibrillation, 3- and 12-lead ECG, external pacemaker, synchronized cardioversion, rhythm interpretation
Medication administration	No medication administration other than oxygen	Limited medication administration: nebulizer for wheezing (asthma), aspirin, nitroglycerin, oxygen	Most cardiac medications: (Amiodorone, Atropine, Diltazam, Vasopressin, Adenocard, Atropine), Calcium Chloride/Gluconate Controlled substances: Morphine, Valium, Lorazepam, Midazolam, Steroids, Magnesium (Preeclampsia), Pitocin
Training	40 to 50 hours	Approximately 109 to 300 hours; CPR trained	Varies according to program: 400 to 1,500 hours Advanced Life Support (ALS), Pediatric Advanced Life Support (PALS) or equivalent

Table 4.1: Comparison of Advanced Life Support (ALS) skills with Basic Life Support (BLS) skills.
(AED = automatic external defibrillator; ECG = electrocardiogram; CPAP = continuous positive airway pressure)

It is a common misconception that most prehospital EMS systems are ALS-based; in fact, the more common model is a BLS-based system augmented with varying ALS skills.

EMS Responses in a Disaster

In addition to their usual emergency responses, prehospital EMS provide the primary, official, medical responses to a disaster setting. The following describes the different types of emergencies and disasters and their impact on EMS operations:

1. Multiple casualty incident (MCI):

- a. An MCI involves ≥ 5 victims, requires a potential change in routine daily operational procedures, and may impact other local 911 EMS activities (i.e., ambulance availability).

Supervisory personnel are involved to assess the situation.

- b. The system may be stressed, but is not overwhelmed.

An example of an MCI is a bus accident or a motor vehicle incident with multiple casualties.

2. Mass casualty:

- a. The number and nature of presenting victims in a given time period exceed the local EMS system's capability to provide appropriate, usual practices of time-sensitive care or the transport of victims.

Examples of a mass casualty include the collapse of a sports stadium with multiple victims, a tornado in a rural community, or the bombing of a heavily occupied public building.

3. Medical disaster:

- a. An event in which the immediate medical demands (transportation or care) overwhelm the existing and/or available emergency resources in the area;
- b. External assistance, including state and/or federal resources.

Examples of a medical disaster include the situations following the Asian tsunami and Hurricane Katrina.

The overall goals of EMS activities in a disaster are to:

1. Safely and rapidly evacuate casualties from a hazardous area to a safe zone (may precede care delivery);
2. Safely and rapidly transport casualties from the incident site to a definitive medical facility;
3. Effect an overall reduction in morbidity and mortality for injured patients;
4. Provide safe, rapid, and effective evacuation with the lowest possible victim mortality through appropriate transport priority selection; and

COLOR	CATEGORY	CLINICAL STATUS	TRANSPORT STATUS
Black tag	Category 0	Non-viable/ Dead/Nearly dead	Do not transport or provide care
Red tag	Category 1	Most critical	Immediate transport
Yellow tag	Category 2	Not as severely injured	Limited transport delay acceptable
Green tag	Category 3	Walking wounded	Non-ambulance transport acceptable

Table 4.2: EMS field triage descriptions

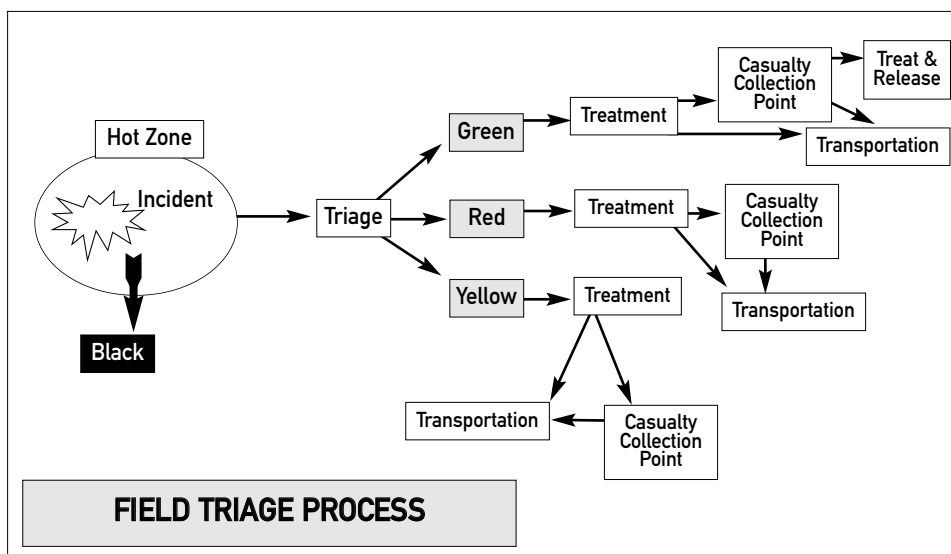


Figure 4.1: Schematic depicting the field triage process and possible designated sectors

5. Provide mass casualty disaster triage, which:
 - a. identifies the most salvageable victims;
 - b. varies according to the number of victims and availability of medical resources;
 - c. requires frequent reassessments and reclassification; and
 - d. varies as a function of disaster site, scope, and magnitude.

Under normal circumstances, EMS staff initiate field triage and establish an organizational command presence. The actions at the scene of a disaster or mass-

SECTOR	FUNCTION
Command post	Area where Incident Command senior supervisors manage the event
Staging location	Destination point for arriving EMS services (not at the incident site)
Transportation	Location from which ambulances will depart with patients being transported to the receiving healthcare facilities or other designated receiving facilities
Treatment	On-scene, safe area where medical care is rendered to victims of the incident. (Normally on-scene care is provided by prehospital personnel, but in the event of an overwhelming event, assistance may be provided by hospital-based nurses or doctors.)
Triage	Location where patients are sorted according to their treatment and transport priority classification
Medevac/Landing zone	Designated location for helicopter operations
Casualty collecting point(s)	Location(s) where victims are sequestered (after triage) according to their triage level. Care may be provided in this area and it can serve as a pre-transport staging victim collection area as well. Ideally, the Red-tagged victims should be removed immediately and not wait in a casualty collection area (assuming sufficient transportation resources).
Morgue	Designated, isolated area for the on-site collection of incident fatalities. An isolated area allows for the initiation of on-scene forensic examination without the need for immediate transport from the scene.
Hot zone/Exclusion zone	The incident exclusion zone where the potential for worker injury or exposure is high.

Table 4.3: Designated organizational sectors and their prescribed function

casualty incident (MCI) are directed at establishing a command and control process for all EMS activities. This process begins with the first arriving EMS unit, which assumes the responsibility of establishing a triage area and communicating with the on-scene emergency responder Incident Commander (e.g., fire or police). The goal of this initial triage is to determine or estimate the number of victims and potential victims, and their general triage categories (Table 4.2).

Field EMS triage is a process by which patients are categorized on the basis of medical transport acuity (Figure 4.1). The purpose of this triage process is to ration limited medical and transportation resources to effect the most good for the greatest number of victims.

The initial EMS crew communicates with the dispatch system and provides an immediate, on-scene status report. This allows for the dispatching of necessary EMS resources and additional administrative personnel. This also

begins the process of assessing the current status and capabilities of the local hospitals and specialty resources (i.e., burn and trauma centers).

It is not the function of the initial, responding EMS crew to begin the transport or immediate treatment of on-scene victims. Their initial priorities are administrative, providing triage and essential communications until additional resources arrive at the scene. Often, this is a frustrating time for EMS personnel and other emergency response personnel whose natural reaction is to assist victims; however, it is necessary to ensure that all patients are accounted for and correctly triaged, and that command is established to coordinate other arriving EMS units and resources.

Once other EMS resources have arrived at the scene, the organizational process begins by establishing the required sectors to manage the situation. These sectors are outlined in Table 4.3, and may vary depending on the scope and nature of the incident.

Health care at the scene of a disaster normally is limited to basic life support services. Intravenous medications and endotracheal intubation are late treatment options depending on the number and degree of injuries and the available emergency care providers. This limitation of care requires that hospital personnel be prepared to provide immediate and aggressive interventions of transported victims.

Mass-casualty disaster triage has very specific, yet limited, goals: to identify the most salvageable victims and deliver them to definitive medical resources. Additionally, the EMS system is responsible for the transfer of a large number of victims to a limited number of hospitals. This may require the transport of victims to facilities beyond the immediate region based on frequent hospital status updates.

Scene Difficulties

Delays in the transportation of victims should be expected; the first patients transported by EMS likely will begin to arrive at the hospital within 90 minutes after the event. Transportation delays are an inevitable consequence of standard operating EMS procedures compounded by scene confusion, scene assessment, and the establishment of safe areas of operation. Access to the immediate disaster area and to the victims may be delayed due to physical barriers or distant locations (e.g., subway or train tunnel), as well as concerns of potential, secondary, explosive devices or structurally unsafe areas.

Other common problems at mass-casualty incident sites include:

1. Failure to organize and separate victims based on triage categories;
2. Failure to transport critical Category 1/Red tag victims as soon as transportation resources allow;
3. Failure to establish a safe, efficient, and appropriate patient

- treatment area(s) that is out of the immediate hazard zone, yet easily accessible to transportation resources;
- 4. Premature transport of stable (Category 3/Yellow tag) victims;
- 5. Delayed request for additional resources and failure to foresee potential needs for specialty resources; and
- 6. Inadequate and inefficient communications from the disaster site — a recurrent problem identified at every disaster critique.

Communications

One of the first systems to fail during a disaster is the communications system. All hospital staff should work under the presumption that early and predictable communications from the disaster site will not occur. Typically, notification of the event becomes manifest with the first wave of arriving or transported victims to the facility. In a catastrophic event, prehospital EMS activities, such as developing a management strategy and implementing organized rescue actions while trying to control the scene chaos, may take priority over communication with local hospitals. In addition, EMS systems possess limited capability to communicate by radio with other emergency response agencies (i.e., fire and police) and may not be able to provide complete information about the event to the hospital. The use of mobile phones also is of limited value as the inevitable and consequential increase in mobile call volume by the affected community overloads the system. Most EMS systems do not have emergency priority, i.e., dedicated, emergency cell channels, and, thus, can become blocked out by public cell phone overload at or near a disaster site.

From the hospital's point of view, early and accurate information allows for better hospital preparedness. When and if possible, the hospital staff should ask limited, but focused, questions of EMS personnel. Necessary information includes:

1. The type and location of event (i.e., explosion, fire, bus/train/plane accident, hazardous materials, actual or potential terrorist incident);
2. The potential number of victims and their general categories (i.e., critical, ambulatory);
3. The general type and nature of the injuries (i.e., burns, blast, penetrating trauma, inhalation); and
4. The population demographics (i.e., pediatric, adult, elderly, dialysis, special needs).

Hospital administration should provide a dedicated communication channel through which the hospital can monitor the event. It is critical that the hospital's request for information be brief and specific with minimal repeated requests for information. Emergency department nursing staff should not become frustrated or demand further information from or periodic contact with EMS personnel. As conditions become stable and safe, the information becomes more forthcoming and at more frequent intervals. The key to field disaster communication is

careful disaster planning and preparedness incorporating the EMS along with the medical infrastructure.

FIRE DEPARTMENT FIRST RESPONDER ROLE

In a disaster setting, fire departments play a number of roles, although their primary and immediate tasks are the mitigation and control of the immediate consequences of the event. In the case of a terrorist bombing or industrial catastrophe, this may involve fire suppression in order to make the environment safe for rescue operations. Their subsequent roles include the search for and rescue of trapped and injured victims, and assisting in victim removal to established medical facilities or treatment areas.

The Fire Department's first response role is to support the field emergency medical care providers (i.e., ambulance services) by providing additional personnel and resources that enable the emergency care providers to perform their medically directed or basic triage functions. Typically, the firefighter's medical training is limited to basic medical skills, although some fire agencies have paramedics on board the fire apparatus.

Traditionally, the transportation of patients to the medical facility occurs via established ambulance providers, but in a catastrophic event with overwhelming numbers of victims, firefighters may transport victims to healthcare facilities. In this case, information from the transporters may be limited and medical insight as to the victim's clinical status may be lacking. The hospital receiving nurse should be prepared to re-triage rapidly upon the arrival of critically injured victims transported in this manner.

HAZARDOUS MATERIALS (HAZMAT) TEAM

The response to hazardous materials at the scene is the responsibility of a Hazardous Materials (HazMat) Team, comprised of specially-trained fire department personnel. In general, hazardous materials are materials that are capable of causing injury to individuals or to the environment. Decontamination is performed by the HazMat Team to reduce or eliminate the danger(s) to exposed victims and personnel, and to avoid spreading contamination beyond the immediate scene. The result of a natural or terrorist event may require that the process of decontamination or contamination reduction be implemented immediately at the scene.

Upon arrival, the HazMat Team performs a scene evaluation during which they:

1. Identify any life threats to responding emergency personnel;
2. Identify any life threats to victims within the identified area;
3. Identify the offending substance, if possible;
4. Measure and monitor the levels of multiple gases: oxygen, combustible gases (e.g., methane and propane), carbon monoxide, and hydrogen sulfide;

5. Measure and monitor radiation sources and the presence of suspicious gases (e.g., organophosphates and chlorine);
6. Determine the appropriate type of protective respirator and chemical suit required by emergency responders; and
7. Determine the need for decontamination, i.e., the removal of contaminants by washing the victims prior to transport.¹

Field decontamination procedures normally involve an unclothing process in a privacy tent. Victims enter the decontamination zone, remove and bag all their clothing, then proceed through the showering process. Thereafter, they can be transported to a healthcare facility for assessment and definitive care.

In the event of a mass-casualty incident, in which large numbers of individuals are exposed to a chemical, biological, or radiological source, the field decontamination process becomes more of a “contamination reduction” effort rather than the complete removal of all contaminants from all patients; fire trucks with spray hoses may be utilized to provide mass decontamination. Most contamination can be reduced 85–90% by simply removing the outer clothing from exposed victims.^{2–5} However, receiving hospitals must be prepared to monitor the victims as well as the staff for signs of exposure, should the contamination reduction not have been sufficient, or if a victim has somehow eluded the contamination reduction process.

Theoretically, only fully decontaminated patients should be transported by EMS. However, in the 9/11 terrorist attack in New York City, grossly “dust contaminated” victims arrived at area healthcare facilities via EMS; victims had not undergone any decontamination or contamination reduction process, resulting in dust contamination of the receiving healthcare facilities. However, this did not result in facility shutdown or known staff injury.⁶

Victims who are unable to remove themselves from the contaminated environment will be removed by Fire Department personnel in the easiest and quickest manner without immobilization or even the administration of oxygen. This is under the premise that the best immediate medical care for these victims is rapid removal from the contaminated environment.

URBAN SEARCH AND RESCUE TEAMS

Urban Search and Rescue (US&R) teams, also known as “USAR,” are rescue specialists trained to work within collapsed zones and hazardous environments to recover victims. Additionally, team members have the training and capability to operate in contaminated environments, e.g., a biological, radioactive, or chemical incident.

Many countries have US&R teams with both national and international deployment capabilities. Presently, within the United States, there are 28 deploy-

NYC EMERGENCY MANAGEMENT

During the 9/11 terrorist attack, the New York City (NYC) Office of Emergency Management (OEM), located at 7 World Trade Center (WTC), was destroyed. The agency ultimately established its operations at a local ship/passenger liner terminal (pier). The OEM continued to function out of this location and coordinated the response to the NYC/WTC crisis and the subsequent anthrax events of 2001. The OEM provided medical coordination with the NYC Commissioner of Health and served as the liaison between the city government and the NYC healthcare system. In addition, it hosted, served as a link, and provided logistical support to a senior medical advisory group composed of a cross-section of city healthcare providers, both for the Mayor and the Commissioner of Health. The purpose of the group was twofold: (1) to assist the city in developing an anthrax medical response plan; and (2) to provide public communication for the media. The OEM also assumed the role of assisting and facilitating the other emergency response agencies in their activities.

One issue that was revealed in the aftermath of the 9/11 attacks was the need to address the concerns and needs of the corporate sector of the community. The loss of this sector could have had devastating consequences to the economy of NYC. It was necessary to coordinate and facilitate activities with the corporate sector in order to reestablish vital city services and a sense of “normalcy” to the community. Moves were made to assist the business sector in such a way as to allow them to re-establish the provision of their services and return to normal business activities.

In addition, the OEM was responsible for coordinating large numbers of volunteers and response agencies and collaborated with other city agencies to create the Family Assistance Unit. The latter provided families a single location from which to achieve information and assistance immediately following the events of 9/11.

able teams operating under the direction of the Federal Emergency Management Agency (FEMA).⁷ In Australia, there are US&R teams throughout the states and territories.^{8,9} The Japan Disaster Relief Team’s Search and Rescue Unit has responded to earthquakes in Indonesia, El Salvador, and Turkey.¹⁰

Due to the relatively late arrival of US&R teams, most disaster victims will have been removed from a disaster site by local fire department personnel or by citizens prior to first-responder arrival. However, US&R teams have evolved into primary response groups for large-scale events, such as terrorist events and disasters from natural causes, when there are long-term and/or overwhelming needs for rescue teams. In the United States, US&R team deployments were involved in the 2001 World Trade Center attack, the 1995 Oklahoma City bombing, the 2005 Hurricane Katrina disaster, and the 2003 Columbia Space Shuttle disaster.^{11–13}

Search activities are conducted by non-medical team members using search dogs and infrared cameras. Once a victim is located, the medical members of the team (typically two physicians and four paramedics) arrive to provide medical care and support to the victim throughout the rescue process. Often, rescue efforts are suspended in order to provide necessary emergency care. The rescue paramedics and physicians are experts in the care and management of injuries commonly encountered in victims of a collapse or crush, (crush syndrome, compartment syndrome, and traumatic asphyxia). In addition to airway stabilization, they can perform field blood chemistry analysis (e.g., potassium concentration), apply tourniquets, and, if needed, perform amputations. Under extreme conditions, a member of the medical rescue group will accompany a patient to the hospital and provide valuable information regarding the patient's status and scene situation. However, typically, hospital personnel will not interface with members of the US&R teams.

EMERGENCY MANAGEMENT

Most governments have a designated department or agency that is responsible for emergency or disaster management. Emergency Management (EM) involves mitigating, preparing for, responding to, and recovering from major crises through the coordination of available resources.¹⁴ Emergency Management is a function of local, state, and national levels of government with organized responses beginning at the local levels and escalating up to higher levels of responses if the local agencies' resources become overwhelmed and unable to effectively deal with the effects of the event.

Emergency Management reports directly to the governmental manager and acts as his/her representative. The role of Emergency Management at the time of a disaster is one of support and coordination of the responding agencies, providing a single point of disaster management oversight. The specific degree or scope of EM operations is determined by the particular jurisdiction.

The pre-event role of EM is to develop strategies for potential incidents (based on their likelihood of occurrence and the potential impact), and to ensure a degree of preparedness on the part of the local institution or municipality. Emergency Management assists and facilitates the continued operation of the municipal or state government in crisis resolution. The ultimate role of the designated Emergency Management group is to ensure, or at least initiate, a return of the impacted location (municipality), population, and health system toward its pre-disaster state. This includes developing strategic plans that involve multiple agencies and multiple jurisdictions.

Countries vary with regard to where the EM function resides. Within the United Kingdom, the Civil Contingencies Secretariat, a department of the British Cabinet, ensures the preparedness and resilience of responders at nation-

al, regional, and local levels; further information is available at www.ukresilience.info. In Australia, Emergency Management Australia (EMA) assists the states and territories with capacity-building and provides assistance when the magnitude of an event overwhelms local resources; more information can be found at www.ema.gov.au. Similarly, the US Federal Emergency Management Agency (FEMA) coordinates response and assets in large-scale events (See Chapter 16). Within other countries, disaster management is a function within a department of a ministry, such as the ministry of Home Affairs in India, or the Ministry of Health in Iran.

To provide disaster coordination, EM often establishes an Emergency Operations Center (EOC). The EOC is an identified location that coordinates event information and resources to assist and support the overall incident management. It is not the role of the EOC to assume direct operational control of a rescue and recovery process. The direct operational responsibilities, i.e., Incident Command, are those of the responsible responding public or private agencies. Day-to-day operations are not conducted by the EM group, but may be coordinated within the overall EM structure. The primary role of EM is to assist the Incident Command System (ICS) to establish priorities, and mitigate the incident. The ICS is utilized in the United Kingdom, New Zealand (Coordinated Incident Management), Australia (Australian Inter-Service Incident Management System), Canada (BCERMS), the United States, and other countries. The EOC allows for representatives from different disciplines (fire, police, EMS, health, construction, utilities, the media, and federal/state assets) to meet in an identified location for interagency communication.

The EOC also coordinates the processing of tasks. For example, if the fire department requires a heavy-duty crane for an operation, it does not contract out or seek to obtain the needed equipment. It informs the EOC (via its EOC representative) of the need; EM then contacts the EOC construction representative to attempt to meet this need. If the EOC construction representative determines that traffic control assistance is needed to move the equipment, the EOC requests traffic control assistance from the EOC police representative. This allows for the administrative coordination and assignment of tasks and the central control of incident needs and costs.

The regional Office of Emergency Management should participate with hospitals in disaster planning, and hospital representation should be included in the EOC during an event. EM can assist hospitals in facilitating communications with emergency resources from outside the local area, with obtaining necessary assistance to ensure ongoing health care for the affected region, with overall coordination of healthcare response and appropriate asset distribution, and with communication and interaction with Department of Public Health authorities.

CONCLUSION

During an emergency or a disaster, local first responders attempt to gain control of the scene, rescue victims, and provide prioritized medical care and transportation. In general, the role of the first-response agencies is to effect an overall reduction in morbidity and mortality of the victims. This is accomplished by an integrated and functional emergency response system that includes active nursing participation in disaster preparedness and response. Healthcare facilities should be incorporated into the planning and preparedness efforts of local first responders to ensure that there is a coordinated, seamless flow of patient care from the field into the hospital setting.

ISRAELI EMS RESPONSE TO TERRORIST EVENTS

Israel's EMS practices a "scoop and run" philosophy in responding to terrorist bombings. The first arriving ambulance crew performs a rapid triage, determines critically injured victims, and performs only essential Basic Life Support interventions on-scene in order to expedite the movement of critical patients. An ambulance arrives at the scene within an average of 4.6 minutes; and the first critically injured victim patient is transported from the scene via ambulance within 11.5 minutes after the terrorist event. All critically injured victims are removed from the scene and transported by ambulance within an average time of 36 minutes after the explosion, and all other victims are removed from the scene within an hour.¹⁵

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CHAPTER 5

DISASTER TRIAGE

Jamie Ranse and Kathryn Zeitz

THE TERM *TRIAGE* ORIGINATES from the French word *trier*, meaning *to sort*. Historically, triage was developed by Baron Dominique Jean Larrey in the 1800s to prioritize the assessment and surgical management of casualties resulting from battlefield injuries.¹ Triage in any setting relies on the rapid sorting of casualties and the assigning of treatment priorities, based on established criteria, to facilitate access to appropriate care and optimize the utilization of available health care resources.

Triage is performed in hospital emergency departments (EDs) on a daily basis. In the hospital setting, patient treatment is not based on a “first come, first served” basis, but, rather, on prioritization based on the patient’s acuity level in order to ensure that critical patients are cared for in a timely manner.^{2–4} The most critically ill or injured patients are cared for first, even if their probability of survival is low.

OBJECTIVES:

- Understand the various disaster and emergency triage categories, processes, and systems;
- Describe the differences in triage for the prehospital and in-hospital environment; and
- Describe the three phases of the triage process.

Disaster triage occurs in a disaster setting in which the number of patients exceeds, at least temporarily, the resources available to treat and/or transport casualties within a short timeframe.⁵ Triage involving multiple casualties, as in a disaster, is “a process designed to prioritize casualty care to ensure care is available to those who need it most urgently and that the greatest number of casualties survive.”⁶ In disaster triage, both human and physical resources may need to be rationed to ensure the most effective response and make the greatest difference in outcome. This paradigm shift often is referred to as reverse triage, as it addresses the needs of a population rather than those of the individual.

During a disaster, triage is performed in two distinct contexts: in the pre-hospital setting at the site of the incident, and in the receiving hospital or healthcare facility.

The key to triage is the allocation into a category that not only separates the casualties according to their level of acuity, but also prioritizes their access to care. The prehospital triage process usually commences prior to the arrival of first-responders at the scene of the mass-casualty situation, and often is completed following the final disposition of the casualty.

In addition to categories or classifications, triage systems provide a framework and an order with which to undertake triage decision-making. Triage systems facilitate decision-making regarding who must wait for treatment. In a disaster situation, responders give first priority to those who are most likely to benefit from the available skills and resources and have a good chance of survival and recovery.⁷ Priority for treatment is not given to casualties with minor injuries, whose outcome will not change as a consequence of waiting for assessment and management.

Triage is both a challenging and complex process, particularly in the setting of a disaster. This chapter is intended to provide an overview of triage categories, systems, and processes, as they relate to triage in both the prehospital and in-hospital settings during a disaster situation.

TRIAGE CATEGORIES

There is a diverse array of triage categories, titles of categories, and labels.^{1,8} In the prehospital setting, and, at times, in the hospital, these categories generally are themed as: (1) emergency or emergent; (2) urgent; (3) non-urgent; and (4) dying or deceased. For emphasis and rapid identification purposes, categories usually are defined visually by a color; red usually indicates the most emergent category. The four, broad, common categories used for triage in the pre-hospital setting, along with their associated color and a brief descriptor, are in Figure 5.1.

EMERGENCY (RED)	Severely injured, but recoverable, requiring immediate assessment, simple resuscitation techniques, and transportation to a referral institution
URGENT (YELLOW)	Significantly injured, requiring a time-critical intervention at a referral institution
NON-URGENT (GREEN)	An ambulant casualty in which hospital admission is unlikely; also titled "walking wounded"
DECEASED (BLACK)	Deceased or non-recoverable injuries

Figure 5.1: Priorities and descriptors for common triage categories

Emergency or Emergent (Red)

The emergency or emergent (Red) triage category is the highest priority level assignable to patients and includes those casualties that are severely injured but are considered to be recoverable from their injuries, if treated immediately.^{9,10} These casualties require immediate assessment, simple resuscitation techniques (airway management and hemorrhage control) with minimal resource utilization prior to immediate transportation to a healthcare facility for acute care.⁸ Generally, these patients are experiencing threats to their airway, breathing, or circulation. Examples that may be categorized as *emergent* include patients with extensive hemorrhage or respiratory complications, and patients who are choking.

Urgent (Yellow)

Casualties categorized as *urgent* are those who have sustained significant injuries and will require transportation to a referral institution for a time-critical intervention, such as surgery, but only after the transport of emergency (Red) victims.^{7,10} Examples of casualties that may be categorized as urgent include those with internal injuries or major fractures.

Non-urgent (Green)

Casualties in the non-urgent (Green) category traditionally are referred to as the “walking wounded”; they have sustained minor injuries, but are stable and not likely to require hospital admission. Their injuries are easily treated by first-aid providers at the scene of the incident or at an established on-site medical facility.^{7–10} Alternatively, these casualties can wait for further assessment and/or management at a healthcare facility. It is unlikely that, if not treated in a timely manner, these casualties’ injuries/illnesses will result in disability or permanent damage. Examples of casualties that may be categorized as *non-urgent* include casualties with soft-tissue injuries, stable fractures, or minor bleeding.

Deceased (Black)

Casualties in the deceased (Black) category are deceased or have such substantial injuries that the expenditure of a great amount of human and physical resources would not affect their likely poor outcome. In essence, these casualties will not receive any treatment other than palliative care, if resources are available. Casualties who are severely injured and not expected to survive are the most difficult to assign, as doing so runs counter to the usual healthcare philosophy of providing care to all. It is important to recognize that casualties placed in this category are so severely injured that a large amount of medical resources is required to resuscitate them; committing this amount of resources to these patients who have a limited chance of survival removes such resources from those patients with potentially survivable injuries, thus reducing the latter

group's chance of a good outcome. These casualties often become the responsibility of the police authority and/or coroner.

DISASTER TRIAGE

Throughout the world, there is no consistent category system or language that groups casualties in a consistent manner in disaster triage. Both the number and type of categories in a triage system may differ between jurisdictions, organizations, and medical response teams. This inconsistency in triage categories, systems, and triage tag design can result in confusion during a multiple-casualty incident, particularly when multiple agencies from multiple jurisdictions are involved. In a survey of all of the eight Australian state and territory ambulance services, Nocera and Garner¹¹ identified the use of six different triage taxonomies and five different triage methodologies and triage tag designs used within one country. These findings highlight the need for the development of a consistent dataset, as well as a consistent triage tag format and design. In Australia, work has commenced in the development of a national standard to address such issues.¹²

Triage Process

The triage process includes all assessment activities undertaken by healthcare workers to determine the appropriate triage category for a casualty.⁶ The time to perform the assessment varies from two–five minutes, depending on the number and type of measurements performed. The triage process is complex and influenced by a number of factors, such as the experience and training of the clinician performing the triage, the perceived resources required, the application of traditional triage processes, such as whether or not to use triage tags/cards, and the age of the casualty.

The provision of resources to casualties requires not only excellent clinical judgment, but also ethical consideration.^{5,13} The distribution of resources is undertaken to achieve one of the main concepts of triage — to do the greatest good for the greatest number. Doing the greatest good for the greatest number is a concept that implies that both human and physical resources must be shared by all casualties to ensure that the largest number of casualties possible survive the event with optimal outcomes.¹⁴

The age of the casualty may influence triage decision-making, either consciously or subconsciously. This was demonstrated in a study of ambulance paramedics regarding the care of casualties in various multiple-casualty situations.⁶ The participants' responses indicated that ambulance paramedics assess and manage younger casualties first, when compared to older casualties with the same presenting condition.

The triage process occurs multiple times throughout the disaster situation, commonly beginning prior to contact with any casualties, progressing to

the on-site assessment and management of the casualty, and repeated at various points during the casualty's journey through the healthcare system (Figure 5.2).^{1,6}

Pre-casualty Contact

In a multiple-casualty incident, the triage process begins prior to contact with any casualty. This is highlighted by Robertson-Steel¹ who describes the first stage of triage as the assessment of the situation and required resources. Commonly, this phase is undertaken from a distance and is based on the healthcare professionals' experience of similar situations. Arbon *et al*⁶ support this notion and suggest that the triage process commences with the pre-event stage, prior to any contact with a casualty. It is in this stage that clinicians delineate their roles and consider both the required and available resources.

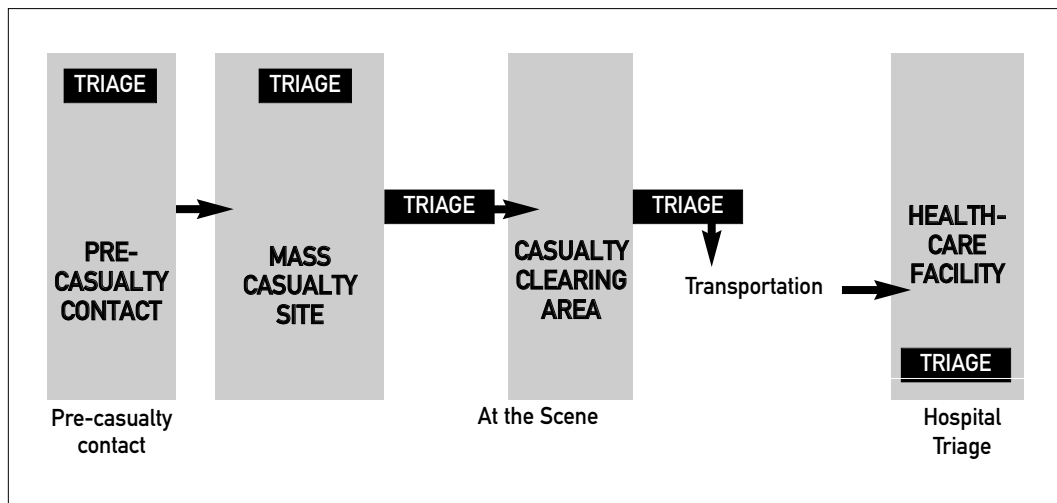


Figure 5.2: Casualty journey/triage points

Currently the literature supports the concept of triage beginning prior to casualty contact as a pre-hospital principle; however, the concept also is applicable to the in-hospital setting and is demonstrated by the actions and tasks undertaken by clinicians in the gathering of necessary resources, in defining team members' roles, and in preparing the ED and hospital for a surge of casualties.

At the Scene

The on-site casualty sorting process involves classifying casualties using pre-determined criteria scales to assess their healthcare urgency.⁷ The urgency of each casualty's condition is rated and classified into one of the categories discussed earlier.

Triage is an ongoing process: casualties will be re-evaluated and re-triaged frequently.^{8,15} It is reasonable to expect that a casualty's condition will improve

or deteriorate, depending on the management of their injury/insult. This results in the re-classification of the patient into a different triage category.

Much of the disaster response literature discusses the establishment of casualty clearing areas.¹⁶ The use of casualty clearing areas emerged from wartime situations in which casualties were moved from the battlefield to more secure areas for triage and management. The type and location of the event, as well as available resources will determine the need for the establishment of casualty clearing areas away from the “hot zone” of the causative incident. After the initial triage, the emergency [Red] and urgent [Yellow] casualties are transferred to the established Casualty Clearing Area where they are re-triaged, management decisions are made based on the available resources, and transport priority is allocated. In essence, these areas become transportation hubs, and reduce congestion at the site of the incident. For some incidents, victims may be triaged and transported directly from the site of the event rather than from a clearing area.

Initially, the Casualty Clearing Area is simply a geographical area away from the hot zone in which equipment and human resources can be pooled and allocated. Casualty Clearing Areas also serve as a base for retrieval teams to become established. Over time, this area can become formalized as dedicated resuscitation areas, and designated points of access and egress for ambulances.

Re-evaluation and re-triaging is important as the casualties’ condition may change quickly in Casualty Clearing Areas. If triage is not undertaken at regular intervals, a casualty may be misclassified into the wrong triage category, resulting in them receiving either too many resources [over-triaged] or not enough resources [under-triaged]. A clinician with experience in triage commonly undertakes this process, rather than the most senior or best-qualified clinician.⁷ Compared to the most senior or best-qualified clinicians, such as an ED medical consultants, triage nurses often are more efficient and accurate in the allocation of a triage category, as they regularly perform the triage process during non-disaster situations.

Once a casualty has been assigned to a particular triage category, all casualties assigned to that same category are placed and managed in a designated common area. For example, all casualties who require emergency treatment are grouped together in the safe zone, separated from other groups, such as the non-urgent casualties. This separation is not necessarily demarcated by a physical barrier or even separated by long distances.¹⁷ Sorting casualties into the various categories and separating them into different treatment areas allow the clinician to allocate human and physical resources appropriately; more human and physical resources are likely to be designated to the area with emergency casualties requiring immediate attention than to the area with non-urgent casualties. This process is similar to that which occurs during the in-hospital triage process. However, the grouping of casualties of the same category within one area is not always possible. For

example, multiple casualties involved in a vehicular accident may be some distance apart and, therefore, a designated triage area may not exist.⁶

Immediately prior to the transportation of casualties to a hospital, the triage process is repeated to determine transportation priorities. This process ensures that the most appropriate casualty is transported by the most appropriate means to the most appropriate referral destination or hospital.^{6,7,17,18} In anticipating the transportation requirements for casualties involved in a mass-casualty incident, careful consideration must be given to the appropriate means of transport (via road or air) as well as the most appropriate receiving hospital (general or tertiary) for each casualty. In some circumstances, this may mean that the most critically injured casualties may not be evacuated from the scene first, but, rather, may remain until the most appropriate means of transportation is available. Such careful considerations can reduce the likelihood of under- or over-triage occurrences. When casualties with major trauma or critical illness are transported to a hospital that is not adequately prepared or equipped to care for the casualty, it is termed *under-triaging*.^{19,20} This may result in the need for the casualty to be transferred to another hospital that does have the appropriate facilities and/or equipment. The impact of this is the additional resources required to transfer the *under-triaged* casualty, and the possibility of removing the healthcare professional from his/her current role in the facility to assist with the casualty transfer. In addition, there is the impact that the transfer has on the casualty's outcome by increasing the time to the access of definitive care.

Over-triaging occurs when a casualty with non-critical injuries is incorrectly prioritized into a higher level than his/her injuries warrant with access to definitive care in an inappropriate place or time. This impacts directly on

TRIAGE PRACTICE IMPLICATIONS: TRANSPORTING CASUALTIES

In response to the Bali bombing in 2002, and the subsequent transportation of some of the bombing casualties to Australia via domestic airlines, clinicians used airplane-seating arrangements in preference to the use of triage tags. Twenty casualties who were identified as requiring ongoing assessment and management were seated together. These casualties initially were categorized as non-urgent (no critically injured or severely ill casualties were transported by this means). The clinicians modified their traditional triage practices to represent the prioritization of medical attention; the standard, non-urgent category (Green) was subdivided into Red for those within that category who required most attention and Yellow for those who required less attention than those in the Red category, but more attention than those in the Green category.¹⁷

the care of other casualties that do require high-level care and may delay the time to definitive care, such as surgery, for these casualties.^{19,20}

TRIAGE SYSTEMS

Disaster triage systems are designed for use in large, multi-casualty events where the human and/or physical resources required to care for everyone at a normal level of response is impossible. Several triage systems have been developed to assist in the application of triage principles. These systems use various criteria to aid decision-making regarding the most appropriate triage category for the patient, and her/his priority for treatment.^{1,7,8,10,21} It is important to note that there are no published data on the validity and accuracy of the various existing and modified triage systems.²² Two examples of triage systems include the Sieve and Sort system and the Simple Triage and Rapid Treatment (START) system.¹⁰

Triage Sieve and Sort

Triage Sieve and Sort refers to a two-phased triage system that is used at two different stages of a MCI. Triage Sieve is performed in the field as soon as possible by the first responder, and is designed for the rapid identification of seriously injured casualties (Figure 5.3).¹⁰

Triage Sieve uses physiological parameters to assess the condition of the casualty and to determine their priority for treatment.

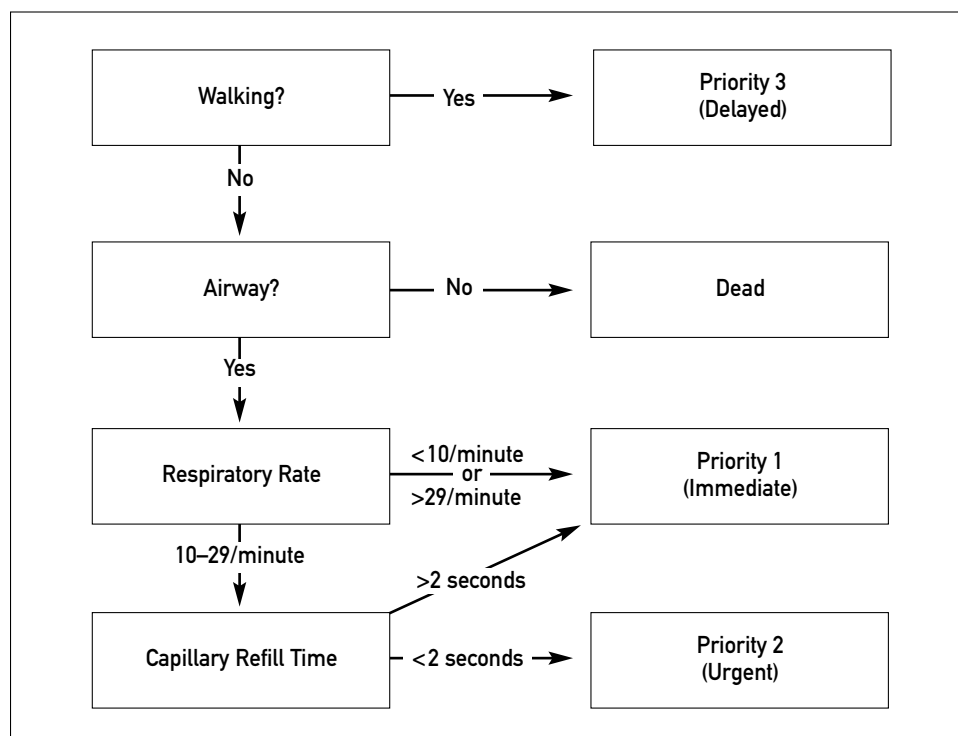


Figure 5.3: Triage Sieve algorithm

In the Triage Sieve process:

1. All walking casualties are immediately assigned to the delayed, non-urgent category (Priority 3). Then, the remaining casualties are sorted following an assessment of airway, breathing and circulation;
2. The patency of the airway is assessed; if not patent, it is opened using a simple airway maneuver. Those casualties who remain not breathing after this simple maneuver are categorized as dead. If the casualty resumes breathing, but the respiratory rate is low (≤ 9 breaths/minute) or high (≥ 30 breaths/minute), the casualty is triaged to the Immediate or Emergency category (Priority 1);
3. If the casualty's respiratory rate is between 9 and 30 breaths/minute, their circulation is assessed using capillary refill time. If the capillary refill time is < 2 seconds, the casualty is assigned to the Urgent category (Priority 2); if the capillary refill time is > 2 seconds, the casualty is assigned to the Immediate category (Priority 1); and
4. When it is difficult or impossible to assess capillary refill time, the pulse rate can be assessed: a heart rate > 120 beats/minute results in an Immediate categorization (Priority 1); a pulse rate ≤ 120 beats/minute prompts an Urgent categorization (Priority 2).¹⁰

The Triage Sort method is more comprehensive than the Triage Sieve method and is performed as a secondary triage at the casualty clearing area. Traditionally, the Triage Sort method was based on the Triage Revised Trauma Score, a scoring system based on the casualty's Glasgow Coma Scale Score, systolic blood pressure, and respiratory rate (Table 5.1).^{21,23,24}

POINTS	GLASGOW COMA SCALE SCORE	POINTS	SYSTOLIC BLOOD PRESSURE (MMHG)	POINTS	RESPIRATORY RATE (BREATHS/MINUTE)
4	13–15	4	> 89	4	10–29
3	9–12	3	76–89	3	> 29
2	6–8	2	50–75	2	6–9
1	4–5	1	1–49	1	1–5
0	3	0	0	0	0

Table 5.1: Revised Trauma Score (RTS). Total score = the sum of the scores from the Glasgow Coma Scale Score, systolic blood pressure, and respiratory rate (range 0–12)²⁴

A low Revised Trauma Score (RTS) is associated with high morbidity and mortality.²³ Using the calculated RTS, casualties are allocated to one of three priorities for assessment and management (Figure 5.4).²⁵

Recently, the various pre- and in-hospital triage categories discussed in this chapter have been implemented throughout the sort aspect of the Triage Sieve and Sort triage system instead of using the RTS.

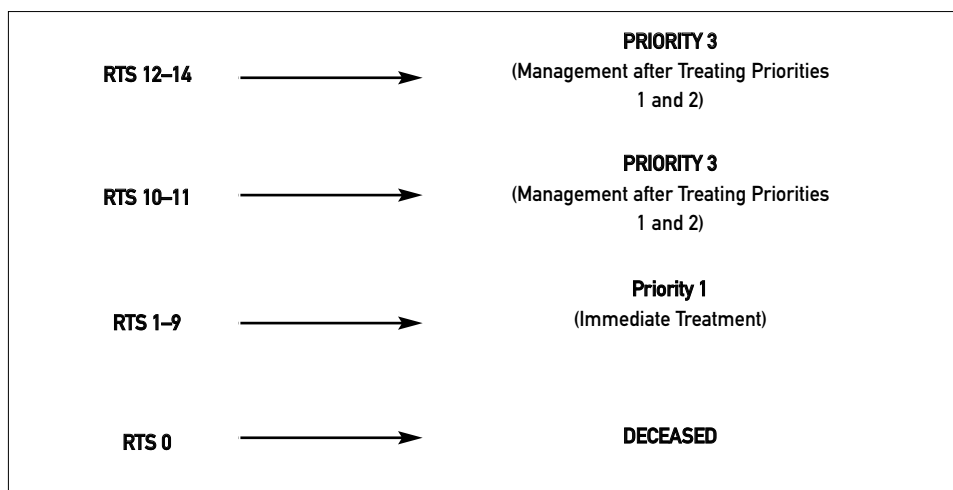


Figure 5.4: Triage categories based on Revised Trauma Scores (RTS)²⁵

START Triage

The Simple Triage and Rapid Treatment/or Transport (START) Triage system emerged in California in the 1990s with a specific focus on field and multiple-casualty triage. START Triage differs from Triage Sieve and Sort in that it focuses on the evaluation of the casualty's respiratory, circulatory, and neurological status, rather than on the casualty's airway, respiratory, and circulatory status (Figure 5.5).^{9,21}

The three goals of START triage are: (1) to sort injured persons based on probable needs for immediate care; (2) to give brief, essential, life-saving interventions; and (3) to recognize futility.¹

START triage is not only about casualty assessment, but about undertaking minimal life-saving procedures, such as simple airway maneuvers, hemorrhage control, and appropriate positioning of the casualty based on their illness or injury (e.g., positioning the casualty with breathing difficulties in the Fowler's position, or placing the casualty with signs of hypovolemic shock in a supine position with their legs elevated). The advantage of the START triage system is that it can be used by all levels of responders and, in particular, can be simplified for use by civilians.

Modified Triage Systems

Many triage systems have been modified and evolved following implementation and evaluation of existing triage systems. Examples of such modified triage systems include:

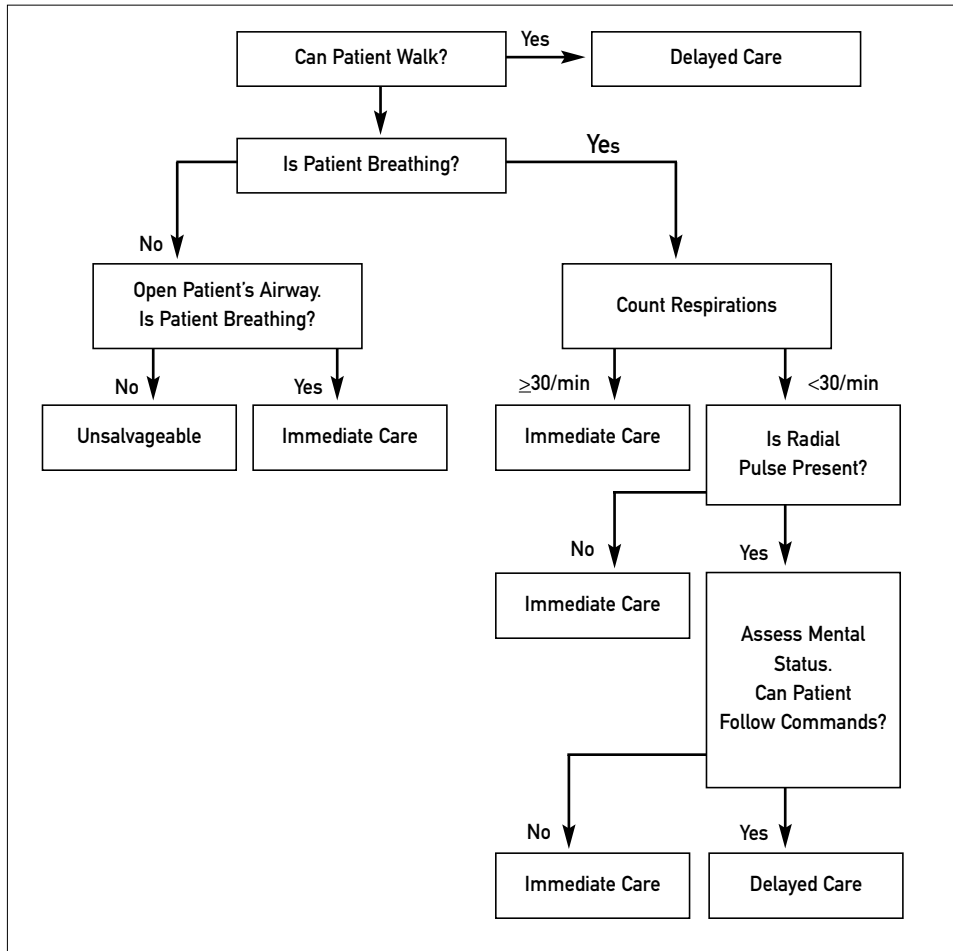


Figure 5.5: START Triage algorithm

- Careflight Triage system;⁹
- Medical Disaster Response system and Secondary Assessment of Victim Endpoint;¹⁵
- Pediatric Triage Tape;²⁶ and
- JumpSTART.²⁷

Most modified triage systems include slight changes in the emphasis of particular physiological signs used in classifying and sorting casualties. For example, the Careflight Triage system differs from other triage systems in that it requires that the casualty's level of consciousness be assessed first and it omits the respiratory rate assessment.

The Medical Disaster Response system is a triage system that is vastly different from other modified systems. Although modified from the START system, the Medical Disaster Response system is extended to include the assessment

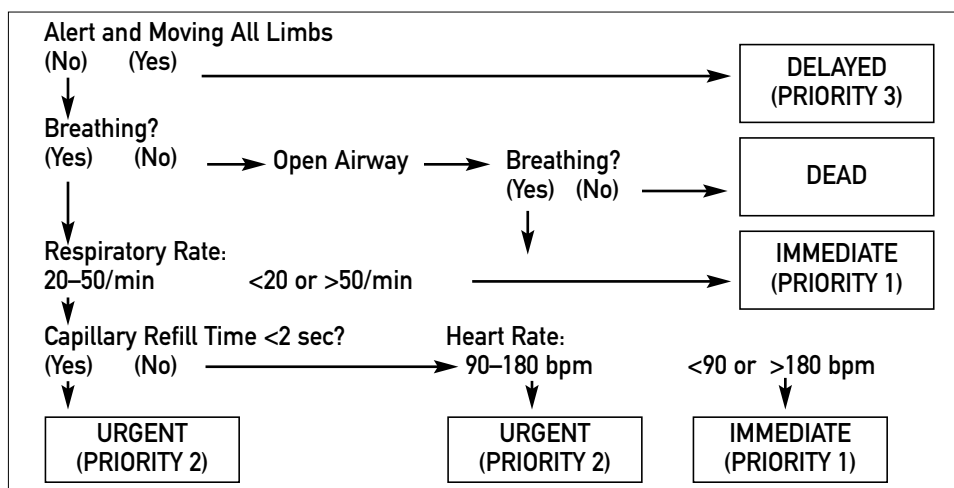


Figure 5.6A: Algorithm for Pediatric Triage Tape measurement 50–80 cm

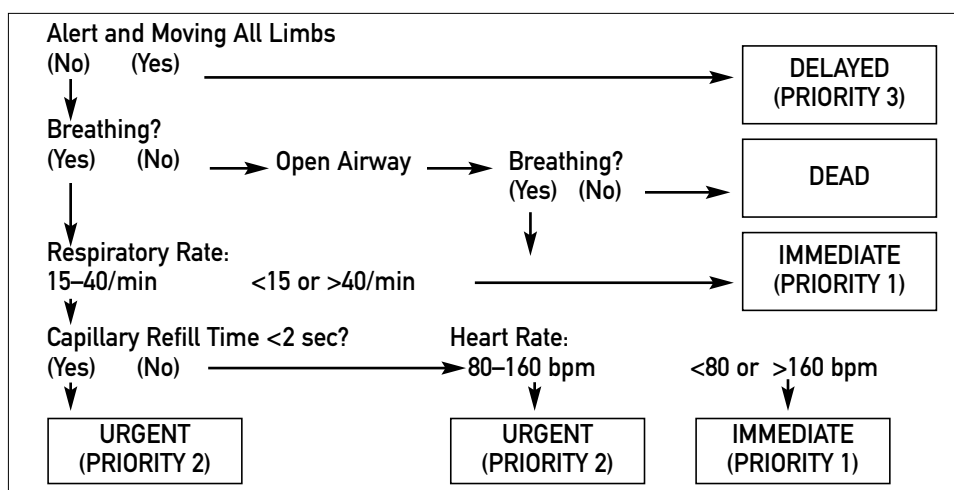


Figure 5.6B: Algorithm for Pediatric Triage Tape measurement 80–100 cm

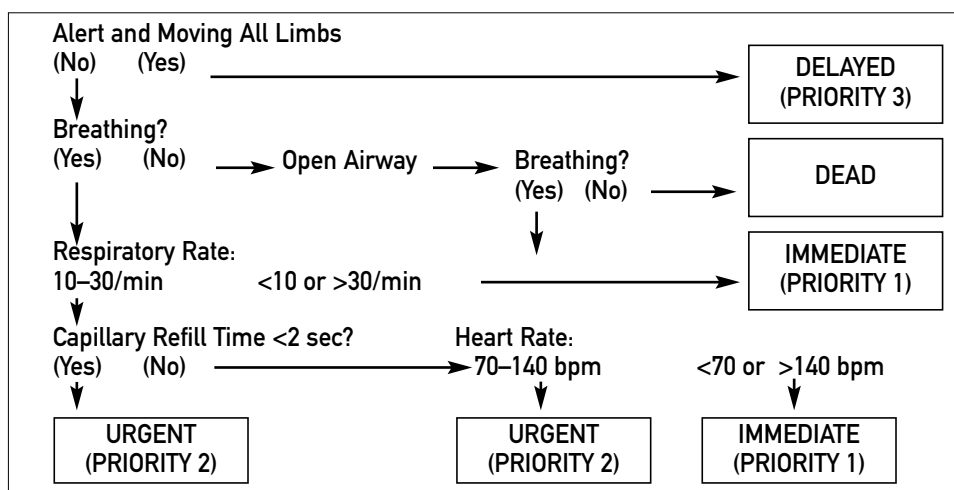


Figure 5.6C: Algorithm for Pediatric Triage Tape measurement 100–140 cm

Figure 5.6: Triage algorithms based on Pediatric Triage Tape measurements of a child's length from head to heel. (A=50–80 centimeters; B=80–100 centimeters; C=100–140 centimeters; min = minute; sec = second; bpm = beats per minute)

and triaging of casualties over many hours or days.¹⁵ The system includes a secondary triage system termed *Secondary Assessment of Victim Endpoint*. In the anticipation that during a disaster, triage may occur over many days, and that the transportation of casualties to an appropriate medical facility may be delayed, the Secondary Assessment of Victim Endpoint uses various sources of information — such as trauma statistics/scores, age, and pre-existing morbidities — to assist in the determination of which casualties would benefit most from the limited available resources. It is this aspect of the triage system that extends beyond the application of the previously described START triage system.¹⁵

Emotional responses, as well as inexperience in assessing injured infants and children, can interfere with the effective triage of children in a mass-casualty event. Triage systems based on adult physiological parameters are inappropriate for use in assessing injury severity and prioritizing the care and treatment of pediatric casualties. For this reason, the Triage Sieve and the START triage systems have been modified for use in the pediatric population in an emergency/mass casualty situation.

The Pediatric Triage Tape is an adjunct to the Triage Sieve system.²⁶ The Pediatric Triage Tape applies a principle similar to that of the Broselow Pediatric Emergency Tape, which uses an infant's or child's length to calculate drug dosage and equipment size for pediatric resuscitation.²⁸ Based on normative values that relate a child's height (length) to its weight and age, the Pediatric Triage Tape correlates a child's measured length to normal values of the physiological parameters assessed with Triage Sieve. The tape is a vinyl, waterproof, measurement tool that is placed alongside a supine, pediatric casualty, from head to heel, to determine his/her length. The tape is divided into four segments: (1) 50–80 centimeters; (2) 80–100 centimeters; (3) 100–140 centimeters; and (4) ≥ 140 centimeters. Each segment or block contains an appropriate Triage Sieve physiological algorithm. Children ≥ 140 centimeters in length or ≥ 10 years of age are triaged as adults. If the child is walking about (the first assessment in the Triage Sieve system), use of the tape is not needed unless warranted by a change in the child's condition. Assessing mobility in infants/children not walking is performed by determining the child's alertness and movement of limbs. The respiratory rate is counted for 15 seconds and multiplied by four, and the capillary refill time is measured by applying thumb pressure for three to seven seconds to the forehead or mid-sternum of the infant or child.²⁹ Figure 5.6 illustrates the Pediatric Triage Tape algorithms based on the child's measured length.

JumpSTART is a modified version of the START triage system developed in 1995 to triage pediatric casualties between 1 and 8 years of age.²⁷ In addition to the inclusion of pediatric vital signs references for the clinician, JumpSTART also directs responders to give rescue breaths to pediatric casual-

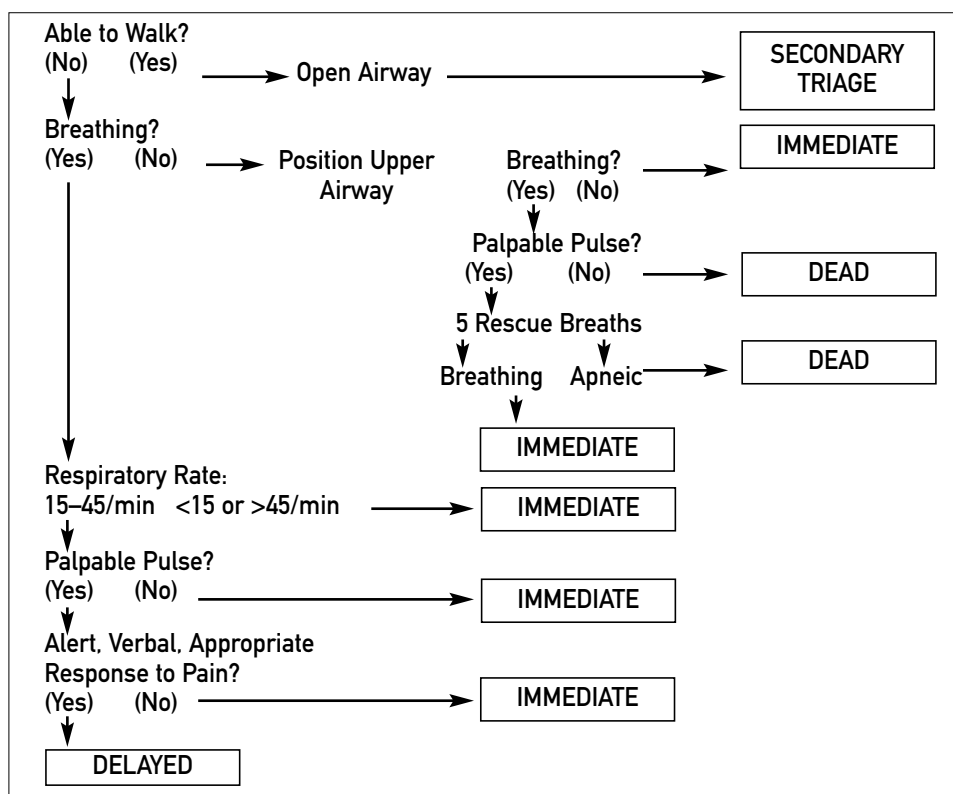


Figure 5.7: JumpSTART triage algorithm (min = minute)²⁷

ties who are apneic but who have evidence of peripheral circulation. The JumpSTART triage algorithm is depicted in Figure 5.7.

Triage Tags

Triage tags or triage cards are visual tools that are used to support triage systems and assist in the identification by other clinicians of a casualty's allocated triage category.^{6,9,21} Triage tags provide responders with a visual cue to determine the next step in prioritizing casualties for assessment and management. Additionally, triage tags provide responders — such as nurses, paramedics, medical officers, and first-aid responders — a place to document their assessment and any interventions provided.

Various triage tag designs exist; however, all include basic data, such as the casualty's vital signs, location of injury or illness, critical interventions, and ongoing treatments, such as medications and intravenous fluids. (Figures 5.8A and 5.8B). Commonly, triage tags are numbered and are secured directly to a casualty, and not to his/her clothing. The triage tag number is recorded and given to the Incident Commander to assist in record-keeping and in determining resource requirements.

Triage Practice Implications: Using Triage Tags

Although triage tags are recommended for all triage situations, Arbon *et al*³⁰ demonstrated that they are unlikely to be used by ambulance personnel in deal-

17737	TIME				
	BP				
	PULSE				
	RESP				
OTHER COMMENTS					
17737					
NAME					
ADDRESS					
TIME/DATE FOUND	CONSCIOUS / UNCONSCIOUS				
LOCATION	HEAD				
	CHEST				
	SPINAL				
	ABDOMINAL				
	FRACTURES				
	BURNS				
TIME APPLIED	TORQUET				
NAME					
ADDRESS					
REASONS FOR DELAY					
TIME/DATE FOUND					
LOCATION					
DRG NAME					
NAME					
ADDRESS					
DATE/TIME FOUND					
LOCATION					
INJURIES					

Figure 5.8A: Triage tag example (front)

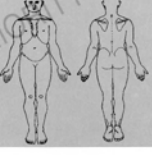
DRUGS AND FLUIDS				17737
TIME	DRUG/FLUID	DOSEAGE & ROUTE	BY	
				RELIGION IF KNOWN
				17737
DATE/TIME				
CERTIFIED DEAD BY				
TAGGED BY				
POSITION MARKED				
PHOTOGRAPHED IN SITU				
EXAMINED BY PATHOLOGIST				
NAME IF KNOWN				
ADDRESS IF KNOWN				
NAME				
ADDRESS				
TIME/DATE FOUND	CONSCIOUS / UNCONSCIOUS			
LOCATION	HEAD			
	CHEST			
	SPINAL			
	ABDOMINAL			
	FRACTURES			
	BURNS			
TIME APPLIED	TORQUET			
FOLD TO SHOW ONE COLOUR ONLY				

Figure 5.8B: Triage tag example (back)

ing with multiple-casualty triage at the scene of motor vehicular accidents. This study revealed that it was common for triage tags not to be used based on the concerns that: (1) they hindered fast and effective assessment and management of casualties, particularly when re-triaging casualties; and (2) it takes considerable time to access the tag, write on it, fold it, and replace it before moving on to the next casualty. The alternative method involves memorizing the casualty's injury/illness and response to management. However, participants stated that when "more than a handful" of casualties existed, or when there were too many casualties to permit memorization, they would use triage tags.

IN-HOSPITAL TRIAGE

Once casualties arrive at the receiving healthcare facility, they undergo an extensive triage re-assessment.¹ This process commonly is undertaken by an ED nurse and is similar to that of triaging in the prehospital setting, with an aim to determine healthcare priorities based on the casualty's current condition and available resources.

Enormous pressures are placed on the hospital to manage large numbers of casualties effectively. In these circumstances, the in-hospital triage categories may be applied in a reverse order. This is termed *reverse triage* and originally was used during wartime when soldiers with minimal injuries were treated before those with severe injuries in order to return them to the battlefield more quickly.³¹ Although this is not the aim of reverse triage in the civilian hospital environment,

the principle of treating less injured victims first has some applicability.³¹ For example, casualties with a low acuity level are likely to be discharged and advised to seek medical aid at a later point in time, while casualties categorized as high acuity would be treated promptly. The simple, but fast and effective management of casualties in these categories may prevent increased morbidity or mortality. Casualties who, under normal circumstances, would be categorized as a Priority or Category 1, would be triaged reversely and, thus, treated last, as it could be perceived that they would require extensive amounts of human and physical resources to appropriately manage their injury and/or illness. In essence, reverse triage serves to provide the greatest good for the greatest number.

Similar to prehospital triage categories and systems, in-hospital triage categories and systems can differ between hospitals and jurisdictions.⁴ Institutions generally use a three-, four-, or five-level triage classification system. Studies suggest that the five-level triage classification is associated with a high degree of accuracy and inter-rater reliability.³² All five-level triage classification systems use the number “1” to represent patients with the highest acuity, i.e., those patients requiring a time-critical intervention, and the number “5” to represent those with the lowest level of acuity, i.e., those not requiring a time-critical intervention.² Examples of five-level, in-hospital, triage classification systems include the Australasian Triage Scale (ATS) used in Australia and New Zealand; the Canadian Triage and Acuity Scale (CTAS) used in Canada; the Manchester Triage System used in the United Kingdom; and the Emergency Severity Index (ESI) used in the United States.^{4,33}

Australasian Triage Scale

The Australasian Triage Scale (ATS) is a triage classification scale based on the clinical urgency of the presenting casualty. Commonly, the triage scale is determined through an initial assessment by a triage nurse.² During this assessment, the nurse allocates a triage category determined by completing the sentence “This patient should wait for medical assessment and/or management no longer than _x_ minutes.”³⁴ The five categories of the ATS are listed in Table 5.2 along

TRIAGE CATEGORY	TREATMENT ACUITY (MAXIMUM WAITING TIME)
1	Immediate
2	10 minutes
3	30 minutes
4	60 minutes
5	120 minutes

Table 5.2: Australasian Triage Scale³⁴

with the recommended maximum time frame in which it would be reasonable and acceptable for a casualty to wait for treatment.

Canadian Triage and Acuity Scale

The Canadian Triage and Acuity Scale (CTAS) is based on the ATS.³⁵ This triage scale has been used within Canadian Emergency Departments since 1999.³⁶ The scale is regularly reviewed by a national working group that makes changes to the scale based on information generated from the national Canadian Emergency Department Information System, research, and feedback from clinicians.

TRIAGE LEVEL	DESCRIPTOR	TREATMENT ACUITY (MAXIMUM WAITING TIME)
1	Resuscitation	Immediate
2	Emergent	15 minutes
3	Urgent	30 minutes
4	Less urgent (semi-urgent)	60 minutes
5	Non-urgent	120 minutes

Table 5.3: Canadian Triage and Acuity Scale³⁶

Similar to the ATS, triage is performed by a triage nurse who determines that “This patient should wait for medical assessment and/or management no longer than _x_ minutes”. Additionally, this triage scale uses modifiers to assist the triage nurse in discriminating a person’s presentation among the triage levels. First-order modifiers include vital signs, mechanism of injury, and pain severity, whereas second-order modifiers are complaint specific. Furthermore, the CTAS allows for a person’s allocated triage category to be escalated if the person’s wait time has extended beyond his/her assigned triage level maximum waiting time. For example, if a person has been allocated a triage level 5, after 120 minutes of wait time, his/her triage level may be escalated to a 4.

A pediatric version of the CTAS was implemented in 2001 with specific reference to newborns, infants, children, and adolescents.³⁵ Similar to the adult version of the CTAS, there are two sets of modifiers to this triage scale. First-order modifiers include physiological observations; secondary modifiers include pain, mechanism of injury, glucose level, and temperature.³⁶ Both the CTAS and the Pediatric Canadian Triage and Acuity Scale utilize the same descriptors and maximum waiting time as described in Table 5.3.

Manchester Triage System

The Manchester Triage System was developed by the Manchester, England,

Triage Work Group and is used widely throughout the United Kingdom. With this system, a triage category is assigned based on the casualty's signs and symptoms rather than on a real or potential diagnosis. The signs and symptoms that are assessed with this system include: life threat, pain, hemorrhage, level of consciousness, temperature, and acuity.⁴

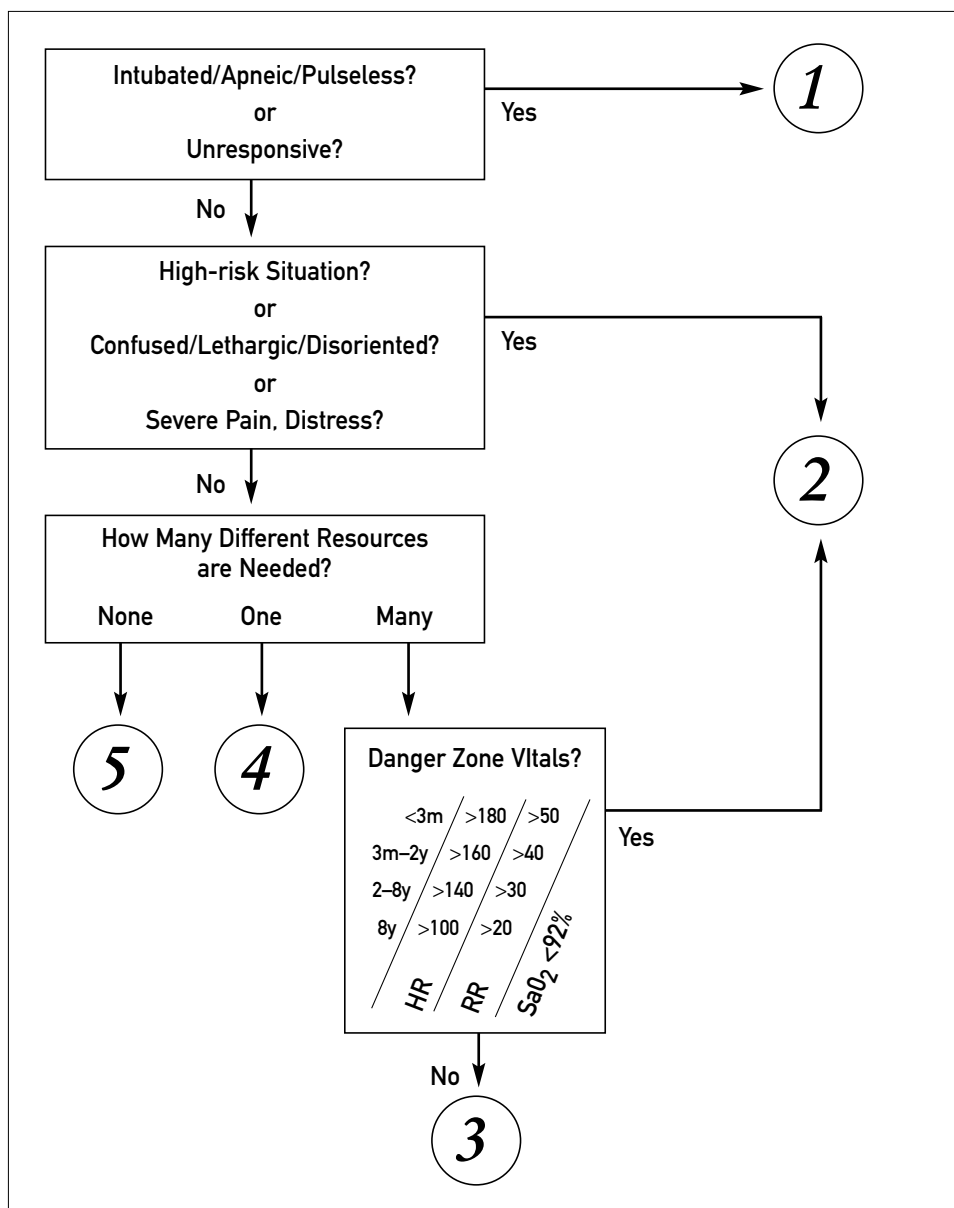


Figure 5.9: Version 2 Emergency Severity Index³³ (m = months; y = years; HR = heart rate; RR = respiratory rate; SaO₂ = arterial oxygen saturation)

Emergency Severity Index

The Emergency Severity Index (ESI) is a triage system based on a conceptual model that not only prioritizes victims in order of who should be seen first and who can wait, but for those who can wait, what resources are required for this person to be admitted or discharged.³² This triage system was evaluated at two university hospitals in the United States.⁴ Following this trial, some minor changes, such as the introduction of pediatric values for triage assessment, were made. The revised triage system was termed Version 2 of the ESI, and consists of five potential triage categories, as outlined in Figure 5.9.³³ Like the Manchester Triage System, the ESI is designed for use in hospital EDs rather than at the site of a mass-casualty incident or disaster.

The development and use of in-hospital triage is based on many factors, such as jurisdictional needs and the skills and knowledge of the healthcare professionals. One example of the evolution of in-hospital triage is the South African Cape Triage Score.¹ Prior to 2006, no consistent in-hospital triage process existed in South Africa and triage primarily was based on an individual nurse's perception of the needs of the casualty.³⁷ The Cape Triage Group, a multidisciplinary healthcare team, convened to develop a triage process to be used consistently throughout South Africa. The end-product was a process that required minimal intervention to determine a triage category, utilizing a unique tool developed to suit the South African healthcare system. This tool encompasses a number of factors, such as mechanism of injury, presentation, pain, and an early warning score to determine priorities of assessment and management.³⁷

TRIAGE PRACTICE IMPLICATIONS: WHO SHOULD TRIAGE, DOCTORS OR NURSES?

In January 2003, bushfires devastated Canberra, the national capital of Australia. Five hundred and one homes were destroyed and four people lost their lives. The Canberra Hospital ED found that the experienced triage nurse performed the triage process more accurately than did the ED medical officers.³⁸

In addition to the load on the ED resources in mass-casualty incidents, other departments, such as operating theaters or intensive care units, may experience a demand for their services. Therefore, it is necessary for these departments and units to undertake their own triage process. Of particular note is the recent development of various protocols and scoring systems for triaging casualties to the intensive care unit during an epidemic.^{39,40} Christian *et al*³⁹ established selection criteria for critical casualties who would benefit from intensive care therapy, excluding those who are manageable within a gen-

eral medical/surgical ward and those who have a chronic illness with a poor prognosis.³⁹ The selection criterion initially is based on the casualty's respiratory or hemodynamic parameters and, secondly, on their sequential organ failure assessment (SOFA) score. The calculated SOFA score is determined by the degree of dysfunction of the respiratory, neurological, cardiovascular, hepatic, renal, and hematological systems. Although, theoretically, this protocol has been validated, it has had minimal testing in real-life situations. In an analysis of intensive care unit admissions in one tertiary teaching hospital during 2007, the retrospective application of these criteria would have resulted in only nine admissions to the general intensive care unit compared to the 219 casualty admissions that actually occurred during the period studied.⁴¹ The benefit of using such defined criteria for admission to the unit is that many intensive care unit beds would be available for management of the long-term surge capacity associated with an epidemic.

TRIAGE ISSUES

Triage education and training underpins the triage decisions of healthcare professionals. To date, triage research has focused on the physiological basis of triage scales⁹ or the comparisons of the performances of healthcare professionals using triage scales.¹⁸ There is limited evidence regarding the application of current theoretical models in real-world triage practice and outcomes. Anecdotally, it is believed that illustrative triage protocols, guidelines, and algorithms are useful for the beginning practitioner; however, advanced practitioners report that they tend not to use such tools, but, rather, rely on a combination of experience, insight, and education.^{6,13} This experience is informed not only by their exposure to disasters, but a variety of challenging situations, including managing complex clinical casualties, their involvement in multi-casualty situations, and working in stressful environments. There is a need for research of the relationship between triage practice, training and education, triage theories, and outcomes.⁶ The training and education of triage techniques are not standardized. This was demonstrated in a study that highlighted substantial variability in the training and education preparedness of nurses prior to undertaking the roles and responsibilities of triage.⁴²

No two disasters are the same and no two triage decisions will be the same. Due to the diversity of situations, casualties, and responders, the decisions and actions undertaken in response to disasters will differ; therefore, triage response must be flexible. In reflecting on decisions made or actions taken, it is easy to be critical of an individual's response; debriefing of those involved in the situation is extremely important. However, debriefing sessions must be in the context of lessons learned from individual responses rather than in the form of criticisms.

CONCLUSION

Triage is a challenging and complex process. Disaster triage relies on sorting casualties and setting priorities to facilitate access to appropriate care and maximize available healthcare resources. Central to the triage process is the classification of casualties based on the severity of their injuries, thereby ensuring the most effective response. Triage in the disaster setting occurs in three phases: (1) pre-casualty contact; (2) at the scene of the incident; and (3) upon arrival at the receiving hospital. Although there are a number of triage systems to support clinician decision-making, there is a dearth of rigorous research regarding “best practice” triage systems, particularly in the disaster or mass-casualty setting.

CLINICAL TRIAGE: THE LONDON BOMBINGS, ON 7 JULY 2005

In July 2005, during the morning rush hour, three bombs exploded simultaneously in the London underground system. This was followed shortly thereafter by a bomb explosion on a London bus. Using the Triage Sieve and Sort method, over 700 victims were triaged, treated at the scene, and subsequently transported to hospital emergency departments within four hours of the explosions.

The London Ambulance Service personnel assessed injured persons at the scene for priority of treatment and for transportation to emergency departments. Using Triage Sieve and Sort tags, the injured were transported to five different facilities.

The London Ambulance Service used triage sieve and sort cards (SMART Triage tags). These cards allow clinicians to base triage decisions on clinical findings and observations rather than the physical appearance of any patient. The ambulances of the London Ambulance Service carry a number of triage cards, thereby permitting responders in the first ambulance at the scene to commence the triage process. During the July 2005 bombings, insufficient triage cards were available on the first ambulances at each scene, due to the high number of people involved. While additional cards were mobilized to the multiple scenes, Ambulance paramedics and emergency medical technicians continued the triage process without the additional triage sort element.

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CHAPTER 6

HOSPITAL IMPACT: EMERGENCY DEPARTMENT

Margaret M. McMahon

THE EMERGENCY DEPARTMENT (ED) plays a pivotal role in any casualty-producing disaster, be it from natural or man-made events. In addition to the ED's well-defined responsibility for providing casualty care, the hospital and its ED may be overwhelmed by non-injured victims who perceive the hospital as a safe haven, a place with intact utilities, a credible source of information, and a place with the capacity to meet basic needs.^{1,2} The heavy demand placed on its wide spectrum of resources at the time of a disaster compels hospitals to be prepared to meet such an unusual workload in a timely and humane fashion. This necessitates that a well-documented and tested disaster management plan be in place in every hospital. Because of the ED's vital role in the hospital's disaster response, both in casualty care and internal and external communication, the ED staff must be involved actively in the development, testing, and evaluation of the hospital's Emergency Response Plan, and must be intimately familiar with all aspects of the plan.

OBJECTIVES:

- Understand the role of the ED during a disaster;
- Understand the principles of the Hospital Incident Command System and its application to ED staff and activities during a disaster; and
- Describe the immediate priorities of the ED during a disaster.

Specific ED disaster activities include casualty receipt, triage, identification, registration, treatment, tracking, and transport, in addition to dealing with the needs of families and the community. The ED also may be involved in decontamination activities and forensic activities, if criminal intent is suspected. ED staff also may be part of an early warning surveillance system for biological or

chemical events. By virtue of its proximity to ambulance loading zones, the ED may serve as a staging area for the evacuation of patients out of the facility in the event of an internal disaster. In some cases, the community Emergency Response Plan may include dispatching one or more teams of ED staff to the disaster site.

EMERGENCY DEPARTMENT NOTIFICATION

Emergency Department notification of a disaster may occur through established emergency medical services (EMS) communications systems, or via informal sources, or may not occur at all. While community disaster plans usually call for early notification of the hospital, experience suggests that notification may be delayed or absent, and that casualties may arrive by means other than the EMS system.^{3,4} Thus, a hospital's first awareness that a disaster has occurred may be when the first casualties arrive. In some instances, law enforcement or media inquiries may serve as the first hospital notification of an event.

The formal disaster notification process varies from community to community. Information may come directly from the scene through normal EMS radio communication, through landline channels, from a dispatcher, or from a pre-designated Disaster Command/Control Hospital or Center that is responsible for distributing casualties among the various hospitals according to their clinical capabilities and casualty workload. In the United States, EDs are required to have radio equipment that enables ambulance-to-hospital and hospital-to-hospital communication, such as the Hospital Emergency Administrative Radio system (HEAR), which allows for a simultaneous "all call" to all area hospitals, thereby eliminating the need to call each facility individually. Typically, when the Disaster Control Center or Hospital is alerted to a possible or actual disaster, the center or hospital initiates an "all call" bed status request to area hospitals; the hospitals are required to provide their current bed status and Operating Room capability. The Disaster Control Center then uses this information to determine casualty distribution. While useful, the HEAR system tends to become overwhelmed in a large-scale disaster, and, thus transmissions may be brief and clinical information limited.

Some communities have computerized systems that track local hospital bed status continuously, eliminating the need for emergent bed status requests; however, these systems may not include ED patients. They also may not be useful in situations in which there are power outages and interference with Internet availability.

Hospital disaster plans may include the use of citizen band (CB) radios supplied by volunteers who bring their radios to the hospital when a disaster is declared or anticipated. Since the CB channels often are not as heavily trafficked during a disaster as are those of the EMS systems, they may provide an

excellent adjunct to standard EMS communications systems. Regardless of the communication modality, casualty information often is limited, and may be as basic as the patient's triage category.

VICTIM ARRIVAL

The timing of casualty arrival after an event is variable, depending upon a variety of factors, including the nature of the event, the number and types of casualties, the hospital services available, the proximity of the hospital to the scene, the community casualty distribution plan, transportation resources, terrain, weather, and whether or not decontamination is performed or required. Disaster casualties often arrive at the ED by EMS ambulance; however, a large number of victims self-evacuate or are evacuated by volunteers and have not benefited from the early organization and prioritization of field triage, treatment, and transport. When casualties arrive by means other than the EMS system, the hospital closest to the scene, regardless of its capabilities, typically receives the largest number of casualties.^{4,5} For example, a terrorist attack using an improvised explosive device (IED) in a popular marketplace may result in a number of seriously injured victims who arrive at the hospital by all available transportation means. An analysis of the train bombing in Madrid, Spain, in 2004 revealed that the hospital closest to the bombing site received hundreds of victims within the first few hours of the event.⁶ In addition, 67% of the bombing victims that were admitted to area hospitals were transported in non-medical vehicles without triage, treatment, or being under any medical control.⁶ In a bombing event, the majority of the victims will arrive at the hospital within the first hour.⁵ In contrast, a plane crash in a remote area generally will be associated with a phased arrival of casualties that are transported by the EMS.

In an incident in which all casualties are equally accessible, the field Incident Command System (ICS) calls for treatment and transport of the most critically injured victims first. However, casualties tend to arrive at the hospital in waves, with the less seriously injured victims arriving first, as they are capable of leaving the scene without waiting for EMS assistance, while more critical patients are extricated and stabilized prior to EMS transport. Thus, it is important for the ED staff to utilize resources judiciously, given that the most seriously injured are likely to arrive later. A third wave of patients may present even later as rescue workers become ill or injured during the rescue operation.⁷ In disasters from natural events, with widespread disruption of services and lack of access to routine health care, a potential fourth wave of casualty presentations may occur days later due to exacerbation of chronic diseases related to a lack of necessary medications or environmental changes,⁸ a lack of dialysis services, psychological and psychiatric disorders, pulmonary and skin infections, and gastrointestinal disorders due to inadequate water supply and hygiene facilities.⁹⁻¹¹

ACTIVATION OF THE HOSPITAL DISASTER PLAN

Generally, the decision to activate the hospital's disaster plan is made by the most senior administrative individual on duty, in consultation with the ED senior physician and charge nurse. The decision is based on the estimated number of casualties, their clinical care needs, and the resources immediately available. The disaster plan also may be activated solely by the ED leadership on duty upon the sudden arrival of a large number of self-evacuated or unannounced casualties. Activation of the disaster plan mobilizes additional staff and resources to cope with the increased clinical workload, and also alerts hospital personnel to curtail routine operations. Facility disaster plans should define the threshold for activating the plan. Small-scale, multiple-casualty incidents (MCI) may be managed completely by the ED, without the need to involve the rest of the hospital. Some facilities have two potential levels of disaster plan activation: standby, and implementation.

Activation of the disaster plan typically is announced through the hospital's overhead communications system, and augmented by telephone calls or run-

ners to areas that may not be connected to the overhead paging system, such as the Operating Room. The code used to announce a disaster is not standardized, and varies from one institution to another, even within the same community. Because of this variability, it is important that all staff, especially agency or temporary staff, have ready access to the facility's emergency code names and definitions. An example of a state-wide standardized Emergency Codes card used in one of the United States is illustrated in Figure 6.1. In addition to the in-hospital alert, telephonic or pager notification of off-site and off-duty individuals is performed. Redundant communication systems should be in place, as land-line and cellular telephone systems may be inoperable. E-mail and the media may be utilized to alert off-duty personnel. In disasters occurring in remote areas, or those with a large number of casualties with conditions that require expert consultation, e.g., burns or radiation exposure, satellite communications with distant centers may be employed.¹¹

	CODE RED — FIRE
	CODE BLUE — ADULT Medical Emergency
	CODE WHITE — PEDIATRIC Medical Emergency
	CODE AMBER — ABDUCTION Infant/Child
	CODE YELLOW — BOMB/ Bomb Threat
	CODE GREY — SECURITY Emergency/Patient Elopement
	CODE SILVER — HOSTAGE Situation
	CODE ORANGE — HAZMAT Situation/Decon Needed
	CODE TRIAGE — DISASTER Situation
	CODE CLEAR — the Situation has been CLEARED

Figure 6.1: New Jersey Hospital Association
Emergency Codes

INCIDENT COMMAND IN THE EMERGENCY DEPARTMENT

Activation of the hospital disaster plan typically involves the implementation of the Hospital Incident Command System (HICS) discussed in Chapter 10, with an Incident Commander and Command Center. The HICS management principles should be mirrored in the ED. Key ED disaster response roles include:

1. Incident Commander — usually the Charge Nurse on duty;
2. Medical Care Director — usually the senior emergency physician on duty;
3. Triage Officer;
4. Clinical Care Personnel Coordinator;
5. Transport Coordinator;
6. Supply Coordinator;
7. Registration and Patient Tracking Coordinator;
8. Communications Coordinator;
9. Security Coordinator; and
10. Decontamination Team Coordinator, if not supplied by a decontamination team.

Whether or not an individual is assigned to each of these functions depends upon the nature of the disaster. In a small-scale event, existing ED staff may be able to manage the event simply by expediting admissions and discharges, or by relocating patients to another treatment area. When it is suspected or determined that incoming casualties will require surgery and inpatient hospitalization, or other extensive resources, a more complex command and control structure may be required.

EMERGENCY DEPARTMENT PRIORITIES

During a disaster, the immediate priorities in the ED are to:

1. Establish/affirm ED Command and Control;
2. Assure communications with EMS or Emergency Management as well as with the Hospital Command/Control Center;
3. Assess the current patient situation in the ED;
4. Brief the ED staff regarding the situation and the action plan;
5. Determine if off-duty ED staff are needed and when; assign an individual to notify off-duty staff (if not done by the Command/Control Center);
6. Communicate the current ED status, as well as updated casualty information, to the hospital Command/Control Center;

7. Free ED treatment beds by either discharging or admitting patients, and identify if patients remaining to be seen should be seen elsewhere or advised to return later;
8. Communicate with patients/visitors regarding the situation and actions to be taken;
9. Assign staff to the triage and treatment areas, and the EMS radios/telephone lines;
10. Notify ancillary departments (radiology, laboratory, operating theatre, etc.) if not already accomplished by the hospital's general announcement;
11. Survey supplies, equipment, and pharmaceutical resources, and request additional items based on casualty information;
12. Evaluate competencies of non-ED staff sent to assist, appropriately assign them, and brief them on ED disaster procedures;
13. Assemble wheelchairs and stretchers near the disaster triage area; and
14. Activate the decontamination team, as needed.

The presentation of victims requiring decontamination creates a unique set of challenges, from both logistical and operational perspectives. In order to prevent contamination of the ED and minimize the need to divide clinical resources, contaminated individuals should be decontaminated before entering the facility. It is impractical for clinical staff to perform complex clinical interventions while wearing HazMat apparel. Because of the high incidence of victims arriving outside of the EMS system, ED personnel must be especially vigilant to the possibility that decontamination of the presenting casualties may be required.

In order to make clinical treatment space available, the ED Medical Officer determines which patients currently in the ED can be admitted or discharged; this is accomplished in an expeditious manner. If the time frame is short, the usual admitting procedures may be modified. Staff from inpatient units may be requested to transport those ED patients being admitted, rather than utilizing ED staff who are busy preparing to receive casualties. ED patients who have not yet been evaluated should be assessed to determine if care can safely be delayed or if transfer to another facility is desired. Some disaster plans may call for all ED patients to be relocated to another treatment area for completion of their evaluation. The situation should be explained to patients and families so that they understand the need for such a relocation.

SUPPLIES AND EQUIPMENT

Existing supplies and equipment should be evaluated in light of the probable needs of incoming casualties, such as the need for standard or pneumatic tourni-

quents in a blast or explosive event. Many institutions have a disaster supply cart stored in the ED or delivered to the ED upon activation of the disaster plan. The contents of the cart should be evaluated in consideration of the anticipated casualties, such as the need for additional age-specific supplies/equipment. Additional crash carts or resuscitation supplies for adults and children may be required.

Supplemental pharmaceuticals (such as antibiotics, pain medications, and tetanus prophylaxis) also may be needed. It is prudent to have a predetermined list of medications and dosages that will be delivered to the ED and other casu-

CATEGORY	DRUG/AGENT
Analgesics	Oral hydrocodone/acetaminophen (5/500)* IV Morphine* IV/IM ketoralac (Toradol) IV/IM Ketamine
Antipsychotics	Oral and IV haloperidol (Haldol)*
Anxiolytics	Oral and IV lorazepam (Ativan)*
Antibiotics	Oral and IV Ciprofloxacin*
Antiemetics	Zofran
Bronchodilators	Albuterol Epinephrine 1:1,000
Intravenous fluids	Normal saline* 5% dextrose/water* Albumin Hetastarch
Drugs for intubation	Etomidate* Succinylcholine* Vecuronium* Ketamine
Drugs for managing patients on ventilators	IV drip diprovan (Propofal) IV drip diazepam (Valium)
Agents for burn/wound care	Silver sulfadiazine (Silvadene)* Antibiotic ointment — Bacitracin* Normal saline for irrigation Local anesthetic — lidocaine (plain and with epinephrine) Wound/skin glue Antibacterial cleansers — Povidone-iodine
Ear preparations for ruptured TM	Cortisporin otic suspension*
Eye medications	Proparacaine* Erythromycin ophthalmic ointment*
Tetanus prophylaxis	Tetanus toxoid*, diphtheria tetanus toxoid or tetanus-diphtheria-pertussis (t-dAP) Hyperimmune tetanus globulin

Table 6.1: Potential ED disaster pharmaceuticals (IV= intravenous, IM = intramuscular; TM = tympanic membrane* Items identified in CDC: In a Moment's Notice: Surge Capacity in Terrorist Bombings: Managing Surge Needs for Injuries: Drugs and Pharmaceutical Supplies. Available at http://emergency.cdc.gov/masscasualties/pdf/Surge_Emergency-Department/pdf.

ality treatment areas upon disaster plan activation. A list of potential necessary pharmaceuticals is provided in Table 6.1. The US Strategic National Stockpile (SNS) also contains medications and medical devices that may be available upon declaration of a disaster.

Assuring an adequate supply of blood products is the responsibility of the hospital laboratory. Emergency blood supplies may be stored in a special refrigerator in the ED as well. Using standardized formulas for determining blood product requirements during a disaster, the American Association of Blood Banks recommends planning for three units of whole blood/casualty.¹³ Bombing casualties typically require more blood products than do other trauma patients.¹⁴ Clearly, the Blood Bank must be kept informed regarding casualty projections as well as their types of injuries.

Identifying the supplies and equipment needed for a disaster is challenging, and highly dependent upon the nature of the disaster and the number of anticipated casualties. The US Agency for Healthcare Research and Quality (AHRQ) has developed a software program that can assist hospitals in determining supply and equipment needs for a number of disaster scenarios (<http://hospital.surgemodel.ahrq.gov/>). A formulary of core medical-surgical supplies needed in a disaster has been developed by the Association for Healthcare Resource and Materials Management along with two health industry distributing and purchasing groups in the United States, and is available at www.ahrmm.org. In addition, the formulary lists needed supplies unique to chemical, biological, radiological, nuclear, and explosive (CBRNE) events. It is helpful to know pre-established usual levels of usage, including the minimum number of items that must be maintained for each scenario, so that the needs can be quickly identified and addressed should an event occur. In a protracted or widespread disaster with severe supply shortages, nurses and other healthcare personnel may need to become quite creative in improvisation and even reuse some disposable supplies. Examples include using perineal pads for dressings, Foley catheters for chest tubes, and single lumen nasogastric tubes for vascular access via a cutdown. In the United States, existing legislation allows the atypical use of supplies during disaster situations.¹⁵ It is prudent to establish, in advance, potential alternatives for each critical patient care item using Auf der Heide's recommendation of a minimum of 120 potential disaster casualties per hospital.⁴

If the ED is affected by an interruption in electrical power, water, wall oxygen, or suction, additional supply and equipment needs must be identified. Requirements for disposable and non-disposable linen and instruments, additional ventilators, and portable oxygen sources should be assessed as well. Patient transportation resources also require attention; the plan may direct each clinical area to bring stretchers and wheelchairs to a pre-established area in proximity to the disaster triage area.

STAFFING REQUIREMENTS

Disaster staffing requirements depend upon the nature and timing of the disaster, as well as the facility's casualty treatment plan. It is important that the ED be used primarily for patients requiring complex assessments and interventions, and that care for patients with less complex problems be provided elsewhere in the facility or off-site. In general, particularly in a short-duration disaster, it is most effective to utilize staff who routinely work in the ED, rather than involve staff unfamiliar with the physical environment and clinical care procedures. However, if victim care needs exceed the abilities of existing ED staff, personnel with similar competencies and skills may be assigned to the ED, working under the supervision of regular ED staff. The ED staff responsibilities then shift from providing care to coordinating care. Criteria to be used for assigning non-ED staff to care for patients in the ED include the individual's expertise in: (1) rapid assessment; (2) Advanced Cardiac Life Support (ACLS); (3) airway management; (4) intravenous access; (5) resuscitation and stabilization; (6) managing several critically injured/ill patients simultaneously; (7) critical thinking; (8) knowledge of disaster principles and Incident Command; and (9) ability to function independently. It is helpful to provide responding non-ED staff with a concise card or Job Action Sheet (discussed in the Incident Command System, Chapter 10) outlining the activities to be performed, as well as any standing orders or protocols that are to be followed. While many care activities can be delegated to non-ED personnel, casualty triage should be performed only by ED staff or an individual who is both expert in triage and knowledgeable of the facility's casualty distribution plan.

In incidents that require off-duty ED staff to be called in to work, it may be useful for the disaster call plan to be organized such that staff members living closest to the hospital are called to duty first. In a short-duration, multiple-casualty disaster that can be resolved reasonably in a few hours, having all available ED staff respond immediately may be appropriate. However, in a prolonged disaster, a percentage of the staff should be requested to respond later; and all should be prepared for extended working hours. ED staff also may be requested to bring personal bedding, additional clothing, and nourishment for themselves for a number of days. Staffing plans also must take into account the fact that some percentage of staff will be unable to report to work because of family issues, pet care concerns, and other commitments. In disasters from natural events, staff may be unable to report to duty for hours or days because of damage to their homes or impediments to travel, such as impassible roads and bridges. In certain types of events (such as chemical, biological, or radiological agent release), staff may not report for work because of concern for their own personal safety or that of their family.^{16,17}

Staffing considerations also must take into account any special characteristics of the victims, such as children, individuals who are physically or

developmentally challenged, psychiatric patients, and prisoners. Finally, the characteristics of the injuries may necessitate additional staff. For example, explosive devices may produce massive, multiple-system injuries, blunt head injury, amputations, pulmonary contusions, burns, eye injuries, and/or ruptured tympanic membranes affecting the patients' ability to hear and communicate. Each of these patients may require the attention of a physician, two or three nurses, and one or two ED technicians until the patient is stabilized. An educational program, "Bombings: Injury Patterns and Care", produced by the Centers for Disease Control and Prevention (CDC) and the American College of Emergency Physicians, is useful in understanding both the mechanisms and magnitude of injuries in bombing victims. This program can be downloaded from www.bt.cdc.gov/masscasualties/bombings_injurycare.asp and is available as a CD-ROM for web-based training at no charge (www.acep.org/blastinjury).

Based on an analysis of the Madrid bombing in 2004 in which more than 270 injured victims arrived at the closest hospital within two and a half hours of the event, the CDC recommends that hospitals be prepared to manage 300 casualties acutely for 72 hours.¹⁸ Precise ED staffing requirements for a disaster have not been defined.

In addition to the normal ED and registration staff, the healthcare team may be augmented with personnel from anesthesiology or dentistry/oral surgery (for airway management), radiology (to perform portable films and/or coordinate patient movement to the department), respiratory therapy, pharmacy, psychiatry, pastoral care, security, environmental services, and supply/distribution. The use of pharmacy staff deserves special mention because immediate access to medications may be restricted in facilities that use automated medication dispensing machines that require special passwords or fingerprint identification — clearly not feasible during a disaster, particularly when nurses from outside of the ED are temporarily assigned to that area. The pharmacy staff can manage the controlled and non-controlled medications, mix intravenous infusions, assist with pediatric dose calculations, and be responsible for medication record-keeping. Child life specialists are essential in disasters that involve pediatric victims. Clergy are particularly important during a disaster not only to provide sacraments of the sick or other rites, but to provide support to patients, families, and staff.

Given the plethora of healthcare individuals who may respond to the needs of the ED during a disaster, and the common problem of individuals responding to the ED who are not requested, needed, or necessarily even credentialed to work at the impacted facility, one staff member should be assigned the responsibility of tracking all personnel who report to the ED, make assignments, and redirect responders to a manpower pool for assignment, if they were not officially assigned to the ED.

ED STAFFING DURING HURRICANE ISABEL

Hurricane Isabel struck the Atlantic coastline of the northeast United States in September 2003.

A study of six hospital EDs in the affected area found that patient census was down by 46% on the day the hurricane struck land.¹⁸ This was followed by a 25% increase above normal census levels over the next five days. The EDs had excess staff on the day of the landfall, when they anticipated an increase in patient volume, and were understaffed the subsequent five days, when patient volume increased. In particular, there was a noticeable increase in patients with minor trauma on the first day after landfall.

Robert Powers

DISASTER TRIAGE

Once the situation has been assessed, the disaster plan has been activated, and actions are underway to clear the ED and other treatment area beds for the anticipated patients, establishing a Triage Area and assigning a Triage Officer and other staff are high priorities. The process of performing disaster triage is discussed in detail in Chapter 5; discussion here is limited to the logistical and operational aspects of disaster triage in the ED.

Location

The Triage Area should be located outside the ED in proximity to the ambulance off-loading zone in order to maximize the efficiency of EMS personnel and routine traffic patterns, funnel casualties not requiring ED services to other treatment areas, and prevent contaminated victims from entering the ED. Ideally, the Triage Area is protected somewhat from the elements; heaters or fans as well as additional lighting may be needed.

Supplies/Equipment

The Triage Area is a rapid assessment area, not a treatment area. Clinical activities performed here include sorting casualties and instituting limited, life-saving measures, such as opening an airway and stopping massive external bleeding using tourniquets or pressure dressings. Therefore, the clinical equipment needed in the Triage Area is limited to such items as oral or nasal airways, dressings, tourniquets, and unsterile gloves. There is no need for a Crash Cart in the Triage Area. Non-clinical items needed in the Triage Area include disaster triage tags, pre-assembled patient charts with a pre-assigned disaster number, pens, indelible markers, a disaster patient tracking log on a clipboard, vests or armbands for the Triage Officer(s) to wear, and two-way radios or cellular telephones for communication with the ED Incident Commander. These items can be contained on a small mobile cart that can be brought to the Triage Area during a disaster. As discussed earlier, wheelchairs and stretchers should be staged close to the Triage Area.

It also may be helpful to have an exchange cart containing sufficient supplies to restock the ambulances; this allows EMS personnel to quickly restock their vehicles and avoid going out of service in order to re-supply them. The re-supply cart may include linens, cervical collars, intravenous fluids/supplies, non-rebreather oxygen masks, nasal cannulae, and dressings. Spine boards also may be placed in close proximity to the Triage Area. As EMS vehicles may be making multiple trips to and from the disaster site, facilitating the return of EMS personnel and vehicles back into service is important to an effective community disaster response.

Triage Area Personnel

Personnel assigned to the Triage area include the Triage Officer(s), Registrar(s), Security Officer, and transporters. Exactly who should serve as the Triage Officer depends on the facility and its resources. Many plans call for an emergency nurse to be the Triage Officer, while others assign a physician to this role. Given that physician resources often are limited during a disaster, and that their expertise is best used where it is needed most, the use of an experienced ED nurse as Triage Officer is a useful strategy. Criteria for the selection of the Triage Officer is that he/she is: (1) immediately available; (2) knowledgeable of disaster triage concepts; (3) clinically experienced in emergency care (and preferably mass-casualty care); and (4) familiar with the institution's and community's Emergency Response Plan.

The presence of Security staff in the Triage Area is crucial for numerous reasons, including vehicle traffic control, protection of the staff and the ED, and communication with the Command Center and elsewhere. Security staff and the Triage Officer should be equipped with two-way radios and/or cellular telephones.

Transporters assigned to the Triage Area may be any available staff members who are physically capable of transporting patients and knowledgeable of the facility treatment areas. Most often, non-ambulatory patients are placed on a wheeled cart (gurney) that can be maneuvered by one person. In some instances, the victim may be on a canvas or makeshift litter requiring a minimum of two or, possibly, four people for transport. Since a variety of people may be serving as transporters, it may be appropriate to assign one person to be the Transport, in order to ensure that transporters know where to take patients, and to continuously reassess transportation resources and needs. Given the workload associated with transporting stretcher patients, victims who can walk should do so, and those who can safely sit in a wheelchair should be transported that way. If possible, victims not requiring ED treatment resources should be routed to the hospital through an entrance separate from the ED.

Triage Process

Victims who are brought to the hospital by EMS usually will have a field triage tag in place and their triage category assigned by EMS personnel. The victim then is re-assessed by the ED Triage Officer and his/her triage category is confirmed or changed and a new triage tag is attached to the victim. Field triage tags should not be removed since that is the way that patients are tracked. The casualty typically is given a hospital disaster medical record number from a pre-assembled list of numbers that correspond to pre-assembled patient charts. The field triage tag number and/or the hospital triage tag number, as well as the assigned triage category and hospital disaster medical record number, are recorded on a triage log. If available, patient name and gender can be added to the disaster triage log. Some communities use disaster triage tags that contain scanable, bar-coded stickers that can be placed onto the disaster triage log. If bar-coded disaster triage tags are used, a hand-held scanner device should be included as part of the equipment needed in the Triage Area. In some triage systems, a sticker from a child's triage tag is placed on a parent's triage tag to assist in keeping families together. The pre-assembled disaster patient chart accompanies the patient to the appropriate treatment area.

Some specific triage considerations include:

1. Assigning only expert clinicians with superb clinical judgment as Triage Officers;
2. Recognizing that triage decisions are based on the information immediately available and unless there are serious flaws in clinical decision-making, the Triage Officer's decisions should not be second-guessed or criticized;
3. Rotating triage staff to allow them to recover and regroup, and to get out of the elements, if triage is being performed outside;
4. Preparing staff who will assume the Triage Officer role with realistic training exercises involving well-moulaged and coached victims in a chaotic setting; and
5. Including triage staff in Critical Incident Stress Management endeavors following the crisis.

Once the triage process has been completed, transporters are advised as to where and how the patient should be transported. Ideally, the Triage Area staff also will notify receiving treatment areas of the patient's impending arrival.

As many EDs have implemented electronic documentation, the issue of record-keeping during a disaster is a concern. Given its impracticality in the Triage Area, the complexities of computerized systems, the reality that external staff may not have access to the system, and the potential for power failures, it is best to utilize the same paper record-keeping used during computer

down-time. Also, utilizing a specific disaster patient chart, with which staff will be unfamiliar due to infrequent use, is not recommended.

PATIENT FLOW WITHIN THE ED

During a disaster, the flow of patients through the ED depends, to a large extent, upon the number of casualties expected, and the treatment areas available. Patients coming into the ED proper should be received by one person, perhaps the Disaster Charge Nurse, who determines where each patient will go and who also assures that each patient is entered onto a tracking system (display board or electronic). If there are disaster and non-disaster patients in the ED at the same time, there should be some way of differentiating the two types of patients on the tracking board. To the extent possible, it is best to reserve ED treatment areas for patients requiring immediate and delayed treatment, utilize outpatient areas for patients with minor injuries, and place expectant victims (i.e., victims not expected to live) in a separate area large enough to accommodate family members. If feasible, doubling-up of patients in an area, or using open bays that can accommodate more than one patient, are ideal ways to promote maximal efficiency of staff and consolidate supplies and equipment. Patients should be grouped in an area according to their triage category. The specific rooms to be used for each triage category should be identified in advance and included in the unit's Emergency Preparedness Plan. Placing signs on the rooms indicating which category of patient is contained therein is helpful for transporters and responders from other departments as well. Ideally, areas designated for critical patients should be in proximity to Radiology and Computerized Axial Tomography (CAT) departments. Part of departmental planning should address whether patients will return to the ED after radiological studies, or go directly to either the operating room or the intensive care unit, depending upon the results of the studies. When there are a number of patients requiring urgent surgery and treatment spaces in the ED are exhausted, the surgical holding room or the Recovery Room/Post-Anesthesia Care Unit may become treatment areas where patients are further stabilized and prepared for surgery.

If the need for operating rooms outstrips existing spaces, or if operating rooms are non-functional, areas that may be used for surgical procedures include outpatient surgical suites, the surgical rooms in obstetrical units, cystoscopy rooms, endoscopy rooms, radiology special procedures rooms, and cardiac catheterization laboratories. The hospital's disaster plan should identify alternative surgical treatment sites. In addition to existing treatment areas, mobile disaster treatment units capable of expanding ED treatment spaces, operating rooms, or intensive care units may be available. For prolonged events, self-contained, mobile, military hospitals or tents also may be utilized.

Within the ED, potential treatment spaces include the waiting room, triage rooms, offices and conference rooms, the Decontamination Room, and hall-

ways. With the exception of the Decontamination Room, these spaces will require quick furniture removal and the placement of oxygen, suction, electrical power, and supplies. The facility's disaster plan should describe all of these options, and the patient tracking board should be adjusted to include these new treatment spaces.

Hospital disaster plans should identify alternative treatment areas in case the entire ED suddenly becomes unavailable, such as from direct damage or contamination. Key considerations in alternate treatment area selection include: (1) access by EMS and the public; (2) proximity to ancillary services, such as Radiology; and (3) ease of patient transport. Large areas commonly considered include the parking lot adjacent to the ED, the hospital lobby, large conference rooms, and the hospital cafeteria. Obviously, each alternate site comes with a variety of logistical challenges. Timely notification of the prehospital EMS and the public, as well as appropriate signage and traffic routing, are crucial whenever alternate sites are implemented.

PATIENT CARE IN THE ED

Planning Considerations

In order to assure optimal patient care, and prevent confusion or misunderstanding, the care of disaster victims in the ED should be based on previously agreed upon and well-communicated written principles and processes. These planning considerations include:

1. Person(s) authorized to activate the hospital disaster plan and under what circumstances;
2. Person responsible for the clinical decisions regarding patient care, e.g., emergency physician, surgeon, Chief-of-Staff, Vice President of Medical Affairs;
3. Roles and responsibilities of the various responders;
4. Person who decides how critical hospital resources (such as CT scan, blood products, operating suites, antibiotics, ventilators, and critical care beds) will be used;
5. Assumptions regarding human and material resources that will be available;
6. Standing orders and protocols;
7. Medical and nursing staffing requirements/expectations;
8. Critical incident stress management;
9. Logistical resources;
10. Assistance from other departments and the community;
11. Competency assessment of non-ED responding personnel;
12. Authorization for the performance of procedures normally not

- within one's job responsibilities (e.g., nurses inserting intraosseous needles or relieving tension pneumothorax);
13. Emergency oversight of mid-level practitioners not usually working in the ED;
 14. Documentation requirements;
 15. Clinical care resources required for various scenarios; and
 16. Modifications in standards of care.

STANDARDIZED TREATMENT PLANS

In order to promote efficiency and appropriate use of resources, ED disaster care should be standardized rather than personalized whenever possible. For example, unless contraindicated, all trauma patients would receive:

- Age-appropriate diphtheria-tetanus or tetanus-diphtheria pertussis vaccine if surface trauma is present;
- The same antibiotic either in a standard adult dose or weight-adjusted pediatric dose;
- The same narcotic for pain management;
- The same anti-emetic agent;
- The insertion of two large-bore intravenous catheters;
- Intravenous fluid resuscitation according to defined goals;
- Blood drawn for the same specific laboratory studies; and
- Supplemental oxygen to achieve a given arterial oxygen saturation.

In addition, specific criteria would be established for:

- Obtaining arterial blood gas analyses;
- Obtaining 12-lead electrocardiograms;
- Obtaining x-rays/computerized tomography (CT);
- Inserting endotracheal, nasogastric, and urinary drainage tubes;
- Monitoring requirements; and
- Physician notification.

Orders detailing these items can be established in advance of the disaster and be readily available to the ED staff. Such a standardized approach is especially helpful for staff who do not normally work in the ED and are accustomed to relying on written physician orders.

CRITICAL INCIDENT STRESS MANAGEMENT

A critical incident is “any significant emotional event that has the ability to produce unusual distress in a normal, healthy person”.¹⁹ The responses to such an event are normal reactions to an abnormal situation, and may be immediate or delayed. Acutely, the individual may be immobilized and unable to perform his/her job responsibilities. Unresolved critical incident stress may have a variety of consequences, including development of Post-Traumatic Stress Disorder (PTSD).

While a number of events may be critical incidents, a disaster has the potential to result in critical incident stress in both novice and seasoned healthcare workers for a variety of reasons. Triage decisions are taxing emotionally. The sheer numbers of seriously injured or ill people can be overwhelming. Needed resources may be limited or absent. Competing ethical issues may abound. Concern for personal safety and liability may weigh heavily. Lack of sleep and unmet basic human needs may alter resilience. Finally, anxiety regarding the well-being of one's family may contribute to the stress. The frequency of critical incident stress in emergency nurses working in disasters may be unappreciated, perhaps because of the difficulty in conducting disaster research. In a study of emergency nurses working in a facility 40 miles away from New Orleans, the United States, during Hurricane Katrina, Battles found that 20% of the nurses had symptoms of PTSD; none of the nurses in this study were provided with Critical Incident Stress Management.²⁰

Critical Incident Stress Management (CISM) is a process used to prevent and manage the stress associated with a critical incident and involves a variety of strategies, including pre-event education and planning, individual crisis intervention (psychological first aid), group debriefing, and referral for ongoing assistance as needed.²¹ Given the potential that the event may interfere with one's ability to perform one's job responsibilities, all team members must be vigilant to this possibility and intervene acutely. Assigning individuals with expertise in crisis intervention to the ED for the primary purpose of supporting the staff, identifying those in crisis, and intervening may be beneficial. This individual also can be responsible for defusing staff members and facilitating formal Critical Incident Stress Debriefings. Critical incident stress may be prevented or minimized by "stress inoculation", which includes education and exercises on stress management strategies, crisis prevention, and the acquisition of the necessary skills and competencies through realistic exercises that mimic the situations that may be encountered, albeit in a controlled environment. Individuals responding to the ED who do not normally work there and, therefore, have not had the benefit of pre-event preparation or experience in the setting, may be particularly vulnerable to critical incident stress and require additional support.

EVALUATION

Although there is on-going evaluation of the ED's effectiveness during a disaster, a formal systematic evaluation of what did and did not go well is important to future efforts and disaster plan revision. While designed to evaluate a hospital's response during a drill, the Agency for Healthcare Research and Quality's tool, *Evaluation of Hospital Disaster Drills: A Module-Based Approach*²² provides a useful framework for evaluating the ED's response during an actual event. Key elements to consider, regardless of the tool that is used, include:²³

- The Incident Command System;
- Communications (both internal and external);
- Clinical care, including triage, patient care, patient flow, patient tracking, and documentation (including information needed for reimbursement);
- Security;
- Materials and resources;
- Decontamination; and
- Worker support.

RECOVERY AND RETURN TO NORMAL OPERATIONS

A key element of the disaster response is identifying and communicating the criteria for the re-establishment of normal ED operations, assuming that the ED was not physically impacted by the event. Both the staff and the community need to know the timing and sequencing of the return to the ED's routine operations. Following a prolonged disaster, especially one in which their personal and family lives were impacted, staff may need additional time off to regroup and recover. Substantial support staff may be required to supplement departmental workforce. Important, too, is addressing the issue of redefining and reinforcing roles and responsibilities, especially when staff had to perform activities that were not within their usual job responsibilities.

PREPARING FOR DISASTERS

A key to individual, hospital, or community preparedness for a disaster is resiliency — the ability to manage the event and return to normalcy quickly. In order to prepare for a disaster, the ED staff must first be prepared in their personal lives by having a personal/family plan that is exercised on a periodic basis. Staff cannot respond effectively if the welfare of their family and pets is not assured. Staff must be prepared for the roles they will play through realistic, scenario-based education, using a variety of learning modalities. There are a number of educational offerings available to assist nurses in preparing for disasters. The Emergency Nurses Association Trauma Nurse Core Course, which includes a chapter on disasters, provides basic education in the resuscitation and stabilization of trauma patients. Basic and Advanced Disaster Life Support courses, developed by the American Medical Association, and the American College of Surgeons' Disaster Management and Emergency Preparedness Course® also may be useful.

CONCLUSION

On a daily basis, most hospital EDs are experiencing dramatic increases in the number of patients seeking care, long delays in treating patients, and the need to

board inpatients while they await available hospital beds. It is difficult to plan and train for disasters when every day is a crisis. However, the ED team is at the frontlines of arriving victims of a disaster and is key to an effective hospital disaster response. Both the staff and facility must be in a constant state of readiness, capable of responding to disasters large and small.

To the extent possible, disaster responses should be integrated into daily work activities, such as routine mock drills or paper scenarios, or using the hospital's disaster triage strategy along with the day-to-day triage system to triage patients on a given day. If the disaster response procedures become part of daily processes, the response in an actual event will be more efficient and less stressful. Disaster preparedness must become a way of life in our homes, communities, and hospitals.

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CHAPTER 7

HOSPITAL IMPACT: IMMEDIATE ISSUES

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HOSPITALS WITH ACUTE and emergency care facilities are part of a community's critical infrastructure, and their failure to achieve an effective and successful response to a disaster situation substantially impacts the well-being of a community and nation.¹ Increasing the capability of hospitals to respond to a disaster requires addressing operational issues that face acute care facilities upon arrival of the first disaster victims.

OBJECTIVES:

- Explain the objectives of hospital security measures during a disaster;
- Describe hospital crowd control concerns and measures during a disaster;
- List and explain the key components of a disaster communications strategy; and
- Describe the immediate impact on and patient flow through the departments within the impacted hospital.

Hospital operational preparedness includes using security measures, such as lockdown and crowd control, particularly with events that result in contaminated patients, to ensure the timely and efficient handling of patients in a controlled environment. Communications systems, often the first to fail in even the most organized emergency management, require back-up systems and compatibility with other agencies' systems to ensure functionality throughout the disaster response.

The smooth flow of patients and the avoidance of bottlenecks, i.e., delays causing a back-up of patients, are other key facets of hospital planning. Delays may occur in a multitude of areas, including the emergency department (ED), diagnostic areas, operating rooms, and inpatient beds, particular-

ly in critical care areas. Organizing the hospital workforce to staff these areas, set up alternate treatment areas, and deliver stockpiled equipment and pharmaceuticals to departments in need are important in ensuring that the facility responds effectively. The development of policies, protocols, and procedures to curtail routine hospital activities in a rapid, safe, sensible, and ethical manner, so that staff resources can become available to respond, also is crucial.² Finally, disaster management plans must include the appropriate, timely, and compassionate handling of the deceased.

SECURITY ISSUES

Need for Security

The growing threat of terrorism and the potential use of sophisticated weapons capable of producing a widespread effect pose security threats for acute care medical facilities faced with the potential arrival of hundreds of victims, families, and media representatives. However, an attack involving a simple chemical mixture also can be devastating. For example, on 20 February 2007, a suicide bomber in Iraq detonated a bomb strapped to a truck transporting chlorine, killing five and contaminating 140 people.³ Improper security measures could result in contaminants entering the hospital and, potentially, could result in the closure of the hospital due to this contamination. Loss of the emergency care capability of a single major hospital through damage or contamination would severely affect the delivery of health services to the community.

Hospital security planning should be designed to:

1. Keep the hospital and its inhabitants safe;
2. Keep the hospital facility operational;
3. Ensure an efficient flow of patients;
4. Protect the hospital from terrorist activity; and
5. Prevent media acquisition of personal patient information.

Lockdown

Lockdown allows the hospital to control access to its facility by locking all entry points; patient and family entry are allowed only through one or two control points that are monitored strictly. This is of particular importance when there are a massive number of casualties arriving that can overwhelm the hospital facilities or when there are contaminated casualties.

Types

The process of lockdown can be accomplished manually or through an automated system. The process must be able to be accomplished as rapidly as pos-

sible; therefore, a system with a single actuating device that is connected to an electronic lockdown system is the most efficient system currently available. Manual lockdown is time-consuming as security staff must physically access each door to lock every entry point. Clear signs must be placed at all locked entry points to re-direct arriving people to the appropriate, controlled entry point. Security staff posted at the entry points determine who is allowed to enter the facility. Security can be enhanced by having all access points covered by a Closed Circuit Television (CCTV) system that is centrally monitored.

Activation

Lockdown should be activated immediately when a hospital is informed of the release of a toxic substance or when a large number of casualties arrive, particularly the “walking wounded”, who require crowd control. As the majority of victims arrive at the hospital by means other than ambulance, the arrival of ambulances is an unreliable signal of the need to initiate a lockdown. After the 1995 Oklahoma City bombing in the United States, only 33% of the casualties were transported to the hospital by ambulance.^{4,5} Effective lockdown hinges on early activation and should have multiple, early triggers; lockdown can be reversed easily if further information reveals that the lockdown was unnecessary.

Contamination

During events involving contamination, the hospital must be prepared to receive victims that have been decontaminated at the scene as well as contaminated victims that self-present to the hospital. The protection of the acute and emergency care facility is essential if hospitals are to continue their core function of providing health care to the community. The ability to lock down a hospital is a key element in the control of contamination. Identification of the toxic substance also is vital in this decision-making process. The installation of fixed chemical or radiological detectors at the facility’s controlled entry point may assist in contaminant identification, but these detectors have limited utility, depending on the agent involved.

Decontamination processes performed at the hospitals should occur outside, in a well-ventilated area. Lockdown processes should support decontamination operations by locating a controlled hospital entry point post-decontamination. Signs and personnel should be in place at all locked entrances to direct arriving victims to the decontamination location. It works well to establish the decontamination zone near the ambulance arrival area; decontaminated victims then can enter the hospital through a control point at the ED entrance. (See Chapter 15.)

Crowds

Crowds assembling at a hospital following a catastrophic event are composed of patients, families, victims seeking shelter, and the media. The organized management of these individuals by hospital security is an important aspect of disaster planning. Additional support from security services external to the hospital, including law enforcement personnel, may be necessary.

Patients

The number of patients arriving at a given hospital during and after an event varies greatly based on the magnitude of the event, the proximity of the hospital to the event site, and the availability of other healthcare facilities near the site. The type of event also will affect the time span in which patients arrive; however, most victims arrive at the hospital within two–four hours following a sudden impact event.^{5–8} This is in contrast to events of gradual onset, such as infectious or biological events, in which victims may not present to the hospital until days or weeks after exposure.^{9,10}

After a chemical or radiological attack, crowds at the hospital will consist of contaminated and non-contaminated casualties. In the case of the sarin attacks in Tokyo, Japan, on 20 March 1995, the majority of the 5,500 casualties, many with symptoms, believed that they had been exposed.¹¹ Triage is necessary to sort the contaminated victims from the non-contaminated ones, as well as to sort those with minor injuries from those with life-threatening ones. As patients are categorized, they must be processed rapidly and, then, quickly moved to the appropriate location (based on their injuries) to reduce the level of cross-contamination, and to maintain crowd control. Individuals who believe they may have been exposed to a life-threatening agent will be anxious for decontamination, reassurance, and treatment. Security staff should be positioned within the decontamination zone to maintain crowd control. Clearly identified pathways, designated waiting areas, and a clear communication system will help to reduce a crowd's anxiety.

Families

To the extent possible, families must be kept together during care to limit anxiety in both the adults and the children; this includes allowing them to undergo the decontamination process together. A tracking system is crucial to ensure that children and their guardians can be reunited if they do become separated or when separation is absolutely necessary for care. This involves taking photographs of children using a Polaroid or digital camera, logging location information with patient identifiers and the photograph, and issuing matching identification arm bands to the guardians and their children.

Family members will arrive at the hospital seeking information on the

whereabouts of their loved ones. The establishment of a *reunification center* at the hospital can help with this process by providing a location that removes these family members from ongoing operations and providing a central site for aiding in locating guardians. Personnel assigned to this center should verify arriving guardians' identity, establish a board display of the photographs of pediatric patients for identification, and have counselors available to assist the families as needed.

Shelter Seekers

Disasters also bring people to the hospital who have neither a definite medical need nor loved ones who are missing. Usually, these people are seeking safe shelter; based on the magnitude of the event, this could impact hospital operations severely. The hospital may be the only operating facility in the community and, particularly if an evacuation has occurred, may be the only available place for people to gather news updates, and find food, comfort, safety, and relief from inclement weather.

Unfortunately, the arrival of people seeking shelter puts another burden on the hospital at a time when it already may be overwhelmed simply caring for those with medical needs. Community disaster planning should address this potential issue by establishing community refugee centers that are in accessible locations throughout the community. However, the failure of community plans may leave the hospital as the "site of last resort" and, thus, the hospital should be prepared for the possibility of needing to provide food and shelter for non-patients when the community has been devastated.

HOSPITALS DURING HURRICANE KATRINA

During Hurricane Katrina, the 11 New Orleans hospitals that were surrounded by flood waters and most impacted by the event, had a combined census of <2,000 patients. However, staff members, families, and residents seeking shelter accounted for an additional 7,600 persons in these hospitals.¹² Some hospitals even housed pets brought in by staff and/or patients worried about their welfare during the storm. This placed enormous demands on the hospital's already limited resources of water, food, sanitation, linens, and staff, as well as hospital evacuation procedures.

Elaine Daily

Media

To effectively deal with a health crisis or emergency, credible, timely, and, as much as possible, evidence-based information must be provided to the public, media, and healthcare system as a whole. The media are an important tool that can be used by public health professionals to help ensure a coordinated re-

sponse to a public health threat, and can help to bring order to the scene. Conversely, poor media communication can contribute to heightened confusion and anxiety for the public and can limit the ability of healthcare providers to manage the crowds and media sensationalism. Media members have been known to attempt to bypass hospital control entry points to obtain direct information when none has been provided.

All media calls to the hospital should be logged, and a holding statement describing the facts, as they are understood at the time, the nature of the crisis, and what action is being put in place must be released as soon as possible. Subsequent media releases should be issued and updated regularly as new information becomes available. Important information and answers to questions must be gathered quickly, as reporters will want information on the scale and impact of the event. If an information vacuum is created, valuable time and resources will have to be used to correct this misinformation.

To be effective, public communication must be done in conjunction with other key emergency and response agencies at a state, province, federal, and local level. Consistent information must be coordinated and distributed using existing networks within the government to meet public needs. Communication with the range of stakeholders that are involved should include targeted messages to all relevant groups. Success also depends on the use of clearly identified, accountable spokespersons, the release of timely and accurate information, and constant evaluation of public communications, in order to generate public trust.

If the hospital sets up its own media site, it must be set up well away from patient care areas, have an appointed hospital public relations staff member to deliver communications, have security measures to ensure that media representatives remain in the appropriate site, and provide for the communication needs of the media.

COMMUNICATIONS

Telecommunications consist of any devices used to communicate information and include land telephones, cellular telephones, satellite telephones, computers, and paging services. Telecommunications are a critical function of normal hospital operations and the hospital's response to a disaster. Communication failures have been reported widely by all emergency services during disaster responses. Communications can become impaired due to either an internal failure (e.g., internal system damage) or an external failure (e.g., severed telephone lines, system overloads).

During the US Oklahoma City bombing, the Presbyterian Hospital, which was located close to the bombing site, experienced major communication problems. Land telephone lines were ineffective due to damage to a telephone exchange near the explosion and a significant increase in telephone traffic. Al-

though cellular telephones were used initially, these also became ineffective due to network congestion. The hospital reverted to handheld, two-way radio communication that also proved inadequate, as there was a large volume of traffic on the system and, without a dedicated emergency channel, communication of critical messages became technically impossible. However, the use of runners within the hospital proved to be effective, and now are incorporated within the hospital's disaster plan.¹³

In Australia, during the Royal Darwin Hospital response to the 2002 Bali bombings, direct communication within the hospital was hampered; disaster information sent to staff via electronic mail was not received by staff who were too busy to check e-mails; mobile (cellular) telephones experienced problems connecting to the network; and landlines were limited.¹⁴ From this experience, it has been recommended that hands-free, mobile (portable) communication devices be used between key individuals.¹⁴ Similarly, an analysis of the impact of London's terrorist attacks on the Royal London Hospital identified a system-wide paging failure that delayed activation of the hospital's Major Incident Plan.¹⁵

The ability to communicate is the cornerstone of disaster response, and facilitates coordination both within an organization and between agencies or organizations. The lack of reliable communication methods can turn a well-intended response into chaos.¹⁶ Conversely, a well-planned communications strategy can greatly assist the coordination of, and response to, a disaster.

Key Components of a Disaster Communications Strategy

Augmentation of Normal Practices

Disaster communication plans and disaster plans, in general, need to reflect an escalation and augmentation of normal activities and systems, as opposed to introducing new systems with which the staff may be unfamiliar or untrained in their use. In times of crisis or chaos, staff members tend to revert to the routine systems known to them. In recognition of this fact, some hospitals have modified their routine practices to enhance their ED disaster response. For example, in the Royal Perth Hospital in Australia, portable telephones were introduced and assigned to the nurse in charge of each section, as well as to the ED Duty Officer and Nurse Coordinator to be used in their daily practice. As the staff became familiar with this system through daily use, it became easy to utilize these telephones as the primary communications system for coordinating response within the ED during a disaster.

Information Communication Technology

Hospitals have become increasingly reliant on computer technology to perform critical functions in areas such as medical imaging, laboratory services, clinical

documentation, policies, procedures, guidelines, templates, communication (i.e., emailing, paging), medical record-keeping, patient registration, admissions, discharges, and the ordering of supplies.

Following the New York World Trade Center (WTC) attacks in September 2001, Mount Sinai New York University Health Group lost its main computer data center, which was located in a building near the collapsed WTC buildings; this center supported data management in three of its hospitals.¹⁷ The Health Group had contingency plans for the possibility of data center outages for up to 24 hours, but not for more prolonged periods of time. Critical systems were not reinstated in all three hospitals until 17 September (six days after the event); all systems were restored by the end of October (seven weeks after the event). This prolonged outage created an enormous challenge to the hospital staff, as they were forced to revert to manual systems, such as hand-written orders and medication charts, and the hand-delivery of laboratory results. These methods were not only labor intensive, but they lacked the safety measures (e.g., allergy checks) offered by the automated systems. In disaster planning, it is advisable to have hard-print copies of all electronic forms on hand for critical clinical information technology applications in the event of computer outages. This necessitates access to a non-networked printer, as networked printers also would be affected in the event of a computer outage, or having paper forms stockpiled and on hand in sufficient quantities for a large number of patients. Practicing the use of these downtime procedures, which are the same as the paper procedures used during a disaster, is important to ensure that staff are familiar with the process.

Power Issues

Telecommunications systems require electrical power either from an electrical grid or from batteries. Without external feeds of electricity, generators are needed to maintain electrically-powered systems, as well as to recharge mobile and satellite telephone batteries, and other technology. During the Hurricane Katrina response, fuel tankers deployed to refuel the generators required to maintain telecommunications were re-routed by law enforcement officers in order to refuel hospital generators; one communications company also reported that two of its back-up generators were stolen during this time.¹⁶

The final report of the investigation of the response to Hurricane Katrina stipulated: "A well-planned and robust emergency communications system should be sustainable at reasonable levels of operation even after electrical power is lost".¹⁶ This could be achieved through back-up fuel supplies in consultation with local experts in this field, as situational factors must be considered (i.e., whether or not underground fuel tanks can be stored safely on-site). Additionally, the purchase of extra batteries for communications devices is

advisable for use in disaster situations; these batteries must be checked and replaced on a regular basis.

Redundancy

Redundancy involves developing back-up plans in case of a systems failure. Redundancy planning for communication systems includes identifying and securing the back-up systems that will be used (such as landline telephone systems, cellular telephone systems, paging systems, and/or alternate communications devices) if all three primary systems fail concurrently.

The US National Disaster Medical System's (NDMS) response to Hurricane Katrina utilized multiple methods of communications, including personal digital assistants (PDAs), Nextel phones (a combined cellular telephone and two-way radio device), satellite telephones, and laptop computers. When one communication system failed, another worked well, allowing them to remain in communication.¹⁸ Risk management methods indicate that the greater the dependency on a system, the greater the level of redundancy required.

During a major incident, it is not advisable to rely on the availability of cellular telephone communications; this has been noted in numerous disaster analyses.^{13,15,16,19} Cellular networks that do remain available during the incident should be regarded as a bonus rather than an expectation. Following the 7 July 2005 bombings in London, cellular network activity exceeded capacity by approximately 20%.²⁰ However, the congestion was successfully managed by the telephone companies, which were able to prevent the system from failing.

The United Kingdom does have a system, Access Overload Control (ACCOLC), that can be activated by the police to ensure that public safety services as well as other authorities have priority access to cellular communication.¹⁹ However, the system is a local, volunteer program that serves a limited geographical area. Authorities in the United Kingdom, Australia, and other countries currently are working with telephone companies (both landline and cellular) to plan management strategies for network congestion in the event of a major emergency.

Although landline telephones generally are more reliable than cellular telephone communication, two-way radio (walkie-talkie) communication is advisable for use within a hospital or organization during a disaster, because it is not reliant on external power or cables and, therefore, is less vulnerable to external factors, such as cables being damaged. However, adequate planning is essential to ensure that channels are available for exclusive emergency use, that regular training and testing of this system are performed, and that back-up supplies of batteries are available. One suggestion to facilitate training in the use of these methods is to plan one day/month when all key stake-

COMMUNICATIONS IN NEW YORK CITY ON 9/11

In the initial response to the events of 11 September 2001, the functions of New York City medical facilities were hampered due to limited, on-scene information. The emergency response agencies were concentrating all of their resources on the anticipated rescue and recovery of up to 3,000–4,000 victims, and an unknown number of rescuers. Thus, their immediate priorities were other than early communication with the hospitals. The physical loss of cellular telephones and the saturation of available cellular networks by escaping survivors and the media quickly shut down all cellular telephone transmissions. This “communication blackout” forced the hospitals in New York City to function as independent entities with little or no official communication. Hospitals also lacked radio capabilities (800 MHz) to monitor or receive direct communication from the scene, and therefore, assumed the worst and established their emergency operations based on rumor and media reports. Following the events of 9/11, the New York City hospital system has worked to incorporate multiple communications systems into disaster planning, including 800 MHz radios, which are capable of communicating with the city’s Office of Emergency Management, other New York City hospitals, and field operations.

Dario Gonzalez

holders communicate via two-way radios; this not only reinforces radio use and technique, but also regularly tests the equipment. As a back-up, runners also may be used; however, runners should have the messages they are delivering written on paper to prevent the delivery of inaccurate messages. Ideally, runners should be assigned to their role and to a specific area.²¹

It is recommended that organizations assess what communications systems they use, identify all potential points of failure, and create back-up systems to deal with unplanned failures. Various reports^{13,16,17,20} that two-way radios, portable landline telephones, and runners are good redundancy mechanisms within a hospital have highlighted the fact that two-way radios and satellite telephones work well external to a hospital in the event of communication failures.

Interoperability

Even when communications systems remain operational, disaster response agencies may experience difficulty communicating with one another because their systems use different frequency wavelengths (e.g., ultra-high frequency [UHF] versus very-high frequency [VHF]), or because the devices being used have different technology and, thus, are incompatible. Even in daily local emergencies, police, fire, and emergency medical services (EMS) agencies often are unable to communicate with each other because of differing systems and channel usage.

Interoperability is the ability to communicate with other emergency service organizations and the ability to communicate with local, district, regional, state, and national emergency operation centers via the same technology. The US Select Committee Hearing on the response to Hurricane Katrina cited that the lack of “interoperability had the biggest effect on communications, limiting command and control, situational awareness, and federal, state and local officials’ ability to address unsubstantiated and inaccurate media reports.”¹⁶

To achieve interoperability between emergency services, strategic planning at a regional, state, province, and national level is required among all agencies. Additionally, a commitment to funding is required by state/province and national levels of government. The emergency services in London, England, are in the process of implementing an interagency communications system, known as “Airwave” technology, which is a secure digital mobile radio system, to replace the London Emergency Services’ old radio system.²⁰ This new system will include the ability to communicate via two-way radio in the deep tunnels of the London Underground transportation system.

In reviewing communication systems functions and dysfunctions during crises management, a UK consulting firm offers the following recommendations to provide organizations with effective communications tools during emergencies:

1. Know what means of communication are available;
2. Understand the capabilities and limitations of available communications systems and make sure that potential users are familiar with them;
3. Know where and how each type of communications system responds to overload and loss;
4. As no one system is more resilient than another, diversity is essential;
5. Never have a communications system that is used only in a crisis, unless it is familiar to all potential users;
6. Use as many means of communication as possible based on assessed risks and impact; and
7. Know with which persons/organizations you will need to be able to communicate during a crisis.¹⁹

DEPARTMENT IMPACT

Health systems must be able to meet the increased demand of patients after acute mass-casualty events that may require specialized care, including trauma surgery for victims with penetrating injuries. Victims may present to the hospital ED either in a steadily increasing stream that will peak and, then, plateau or subside, or in one or more waves or surges that “wash” through the hospi-

tal.²² The impact on the hospital is defined in terms of the casualty load and the resource requirements relative to time. Typically, as the number of casualty presentations increases, the balance of too few resources relative to the time period during which the casualty load continues, causes stress at regional, hospital, and departmental levels; it may even lead to failure from the exhaustion of resources. The capacity of any hospital or regional health service to maintain operations in a mass-casualty incident remains largely dependent on the pattern of casualty presentation, i.e., the volume of presenting patients and the acuteness of their injuries.

As the disaster progresses, the order in which hospital departments are impacted tends to be: (1) the ED; (2) diagnostics — including radiology, pathology, and transfusion services; (3) critical care areas — including operating rooms, burn units, intensive and high-dependency care areas; and (4) general patient wards. There are specific immediate issues in each of these departments that must be recognized and managed to ensure that appropriate levels of care are delivered, and that the continuity of the hospital or regional health services are maintained.

Defining Patient Flow

In general terms, EDs must promote patient flow so that once the casualty is assessed and initial stabilizing management is completed, movement will be unidirectional out of the department.²³ To enable this, plans must include defined patient traffic routes from the ED to radiology, and then on to operating rooms/theatres, critical care areas, and inpatient wards. For high-acuity/priority patients being transferred to intensive care units (ICUs) or operating rooms/theatres (ORs), the designation of a specific area to be used as a holding area is essential as access to both the OR and ICU is likely to be delayed. Trained staff must be assigned to care for these acutely injured patients in this holding area.

Diagnostics

As the casualty load increases with each successive casualty presentation, requests for radiology and pathology services, likewise, will increase. In any situation in which the casualty load outstrips the hospital's capacity, triage decisions must include consideration of departmental resources, such as radiology, computerized tomography (CT), and clinical laboratories. Appropriate access to, and use of, radiological resources can be improved by introducing a radiology triage role into the hospital incident command roles; ideally, this is managed by a senior ED clinician who restricts all radiological examinations to the chest, pelvis, and long bones. In a similar manner, this approach can be utilized in other diagnostic areas and with other procedures.

Critical Care

After high-acuity casualties are assessed and moved from the ED to radiology and pathology services, they may be transported to operating rooms/theatres for damage control surgery, or to critical care areas, such as burns and ICUs, for ongoing monitoring and stabilization.

Intensive Care Units

Even though critically injured patients typically comprise a low percentage of all disaster casualties, Intensive Care Units (ICUs), with their relatively limited number of critical care beds, usually are the first hospital, inpatient departments in which capacity is exceeded.²⁴ Hospitals must plan for ways to increase ICU resources, including altering staff-to-patient ratios, rapidly determining which current patients can be moved out of the unit, creating additional critical care beds in other areas with sufficient monitoring capabilities and trained staff (e.g., post-anesthesia recovery areas), potentially altering the level of patient acuity necessary for admission to a unit, and adjusting normal treatment modalities due to depleted resources. In planning for times of scarce resources, guidelines must be developed that provide clear, ethical, reproducible, decision-making processes to determine patient access to both life-support equipment and life-saving procedures.^{25,26}

Operating Room

The operating room/theatre is another finite, critical care resource in an MCI. Elective procedures, such as routine surgery, can be reduced or eliminated to free staff, facilities, and beds.²⁷ In a review of the hospital re-sponse to the London bombing, it was determined that a restriction of surgical operations to only the minimal procedures required to save life is needed to effectively match the patient load to available capability.²⁸ Triage to determine surgical priorities should be performed by a senior trauma surgeon located in the ED in coordination with the OR charge nurse; this facilitates the prioritization of OR access based on current and projected needs.

Burn Units

Incidents involving explosive blasts, chemical, and/or radiological disbursement, and heat or fires result in increased presentation rates of burn victims. However, most parts of the world have limited or no access to specialized burn units.

Within the United States, there are a total of 1,820 burn beds in 127 burn units; however, most of those beds are occupied on any given day and would not be available for disaster victims. The overall number of available burn beds has decreased due to the recent closure of some burn units, largely related to the expenses of maintaining operation.²⁹ Australia has 12 burn units with 146 burn beds, while the United Kingdom has 33, Germany has 30,

France has 23, and Canada has 15 burn units.³⁰ All available burn care capacity would become saturated quickly in a mass-casualty burn event, and likely would remain so for an extended period of time.

As burn casualties easily may overwhelm local and state resources, a dedicated national burns plan to either deploy medical teams or redistribute patients is an important aspect of the burns plan.³¹ Within the first 36 hours of receiving victims from the 2002 Bali bombings, the Royal Darwin Hospital in Australia was able to evacuate 48 burn victims to burn centers throughout Australia.¹⁴ In a disaster, Australia's Mass Casualty Burn Disaster Plan recommends redefining a severe burn injury as >20% total body surface area burned.³⁰ This adjustment allows for the most critically burned victims to have access to the limited number of burn beds available.

Management strategies may include transferring existing stable and rehabilitative patients to other local hospitals, and to use other, low-acuity surgery wards (e.g., plastic surgery wards) where staff may possess skill sets similar to those of the burn unit staff. An appropriate in-hospital Burn Surge Plan also will identify critical maximum treatment numbers, beyond which other resources need to be identified and obtained.

RESOURCE MANAGEMENT

Bed Space

An immediate surge of victims requires that clinicians evaluate available bed space throughout the entire hospital. Those patients that can be discharged should be discharged expeditiously. One survey of disaster bed capacity in South Manchester in the United Kingdom identified that a large, tertiary, 855-bed hospital could clear 78 beds immediately by deferring surgeries and

TRANSFER OF PATIENTS

Disaster events that result in the closure, or significant reduction, in capability of healthcare facilities may necessitate the emergent transfer of patients. Recommendations from an October 2000 Joint Regional Exercise (J-REX) involving the US National Disaster Medical System include:³³

1. Establish memoranda of understanding (MOUs) with ambulance services and other regional hospitals that detail specific roles and responsibilities during an emergent transfer of patients;
2. Designate a centralized location within the community, not at individual hospitals, where information related to the patients transferred is shared with families and the media; and
3. Ensure proper communication capability to facilitate information communication between hospital coordinators, ambulance services, and community emergency management.

Robert Powers

implementing planned discharges, and that an additional 69 beds could be made available in one–four hours, thereby providing a total of 302 available beds within a 12-hour period.³² A US study found that a similar percentage (approximately 33%) of beds could be made available within 24 hours; this would require support from general practitioners, immediate care facilities, and nursing homes to accommodate some of these discharges.³² In the Western Australian Health Surge Plan, there are arrangements for low-acuity patients to be discharged and monitored at home by local general practitioners and private community nursing agencies.

Alternate care areas within the hospital, i.e., areas where patients usually aren't located, also can be put to immediate use for disaster needs if locations are predetermined and cached with supplies. Areas such as operating rooms, recovery rooms, endoscopy suites and day surgery suites can be, and have been, used as additional temporary intensive care units and treatment areas.²⁷ Existing, non-traditional facilities within hospitals, such as outpatient departments, cafeterias, and auditoriums, also can be used and have the advantage of accessibility to specialist medical care if required.

Operationalizing alternate care areas relies on having both the necessary equipment and available, suitable staff. Areas such as recovery rooms and day surgery suites usually are equipped with appropriate beds, power, oxygen, and suction capability, and can be configured rapidly, if staff is available. Other areas, such as outpatient departments and the cafeteria, can be configured with oxygen, power, computer connections, and telephone lines hidden inside panels or wall boxes that can be activated rapidly. This should be considered in the construction of any new buildings or refurbishments of older areas of the hospital. Having such capabilities allows the area to become operational with the addition of appropriate medical equipment (such as ventilators, monitors, and beds) and, of course, staff.³⁴

Immediate Supplies

To effectively manage an influx of potentially critically injured victims, health-care facilities must have adequate supplies to meet demands. Initially, this will involve a coordinated distribution of supplies that the hospital has stockpiled for emergency use, or the re-distribution of regular hospital supplies from areas of little need to those with critical supply needs. Following the Bali bombings in 2002, the Royal Perth Hospital determined that earlier notification to the pharmacy and the hospital supply department would have facilitated their response.¹⁴ Notification would have enabled earlier ordering and a more seamless supply of medical consumables from health suppliers, particularly those supplies required for the treatment of burn patients, as the health service did not have large stockpiles of needed products. Hospitals may choose to have dis-

aster supplies stockpiled on campus or at nearby storage facilities. Local stockpiles, rather than those stored at the hospital facility, have the advantage of being protected from any damage to the facility and from not being incorporated into the normal daily supply that could become depleted prior to a disaster. One potential disadvantage is that the transport of supplies to the hospital may not be possible if there is widespread community damage. Memoranda of understanding (MOU) or other agreements with local suppliers may allow for the rapid distribution of goods during an incident. For example, a standing agreement with a local supplier of oxygen may prompt the automatic delivery of extra oxygen tanks during a disaster.

Morgue Facilities

A disaster may generate a large number of deceased victims that can overwhelm the mortuary and forensic capabilities of the jurisdiction. Hospital and community plans should address additional facilities to be utilized in a mass-casualty situation, identify the activation triggers for these facilities, and outline the management responsibility for these facilities. Options may include refrigerated warehouses, trucks, or in-hospital facilities.

The rapid recovery of bodies, coupled with inadequate transportation and storage facilities, as occurred in Sri Lanka following the 26 December 2004 tsunami, may force mass burials of victims.³⁵ Although mass burials may seem expedient during the acute phase of a disaster, they impede identification once the bodies are exhumed. The dead bodies resulting from a catastrophic event do not represent a contagious disease hazard³⁶ unless they are victims of a contagious disease, such as Ebola, in which case they would need to be managed carefully to prevent further spread of the disease.

The use of mechanical cold storage sites allows for minimal impact on body deterioration, but poses some logistical problems. Cold storage sites may include industrial cold rooms, refrigerated vehicles, and refrigerated shipping containers. In an area that has been devastated, such facilities may no longer be available and the importation of vehicles and containers requires a supply of fuel and certain levels of maintenance, which are additional burdens to an area that has been devastated. In hospitals, commercial freezers and cool rooms can be utilized in the short term if the local mortuary facilities become overwhelmed.

Non-mechanical cooling of bodies, such as through the use of ice, can be effective but, as was found after the Bali bombings in 2002, is associated with collateral issues (e.g., the melted ice immerses only the lower portion of the bodies producing what has been referred to as 'human soup').³⁷ Storing the bodies on a slightly raised platform can overcome this problem by allowing the water from the ice to drain away.

Chemicals also may be used for the preservation of bodies until identification

has occurred. This method was used in the Summerland disaster in England in August 1973 when the bodies of the deceased were preserved in formaldehyde.³⁸

The handling and examination of deceased victims exposed to persistent toxic substances poses additional problems. In this instance, the main goal is to prevent the deceased from contaminating people and necessary facilities. Temporary morgues can be created that can be decontaminated easily or destroyed after they have been used.

CONCLUSION

The immediate hospital management of massive numbers of casualties from a disaster requires that the necessary staff, supplies, and treatment areas are in place and suitable to provide care for a large number of victims. An effective response is determined by effective planning that prepares all hospital departments that will be impacted by the arrival of victims of a mass-casualty event. Plans for an immediate response must cohesively unite hospital resources in order that heavily impacted areas are supported by those areas that are less impacted and/or with surplus resources.

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CHAPTER 8

HOSPITAL IMPACT: LONG-TERM ISSUES

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WHEN AN EVENT RESULTS in massive numbers of casualties that overwhelm the healthcare system for an extended period of time, or causes significant damage to the existing healthcare structure, the community's health depends on the ability of the healthcare system to sustain services throughout the disaster. Local hospitals are the cornerstones of the community, providing safety and aid without bias. Nursing homes care for elderly family members and friends, while community clinics provide a healthcare safety net for those who are impoverished or in underserved areas. A healthy community depends on multiple components of the healthcare system, including healthcare providers' offices, laboratories, and public health departments.

OBJECTIVES:

- Understand the concept of resilience and its application to disaster preparedness;
- Describe the components of capacity building along with strategies for strengthening each component;
- Give examples of lifelines and contingency plans; and
- Understand priority setting and altered standards of care.

When a healthcare system is closed or becomes damaged and dysfunctional, it is crucial that the system return to at least a minimal level of function as quickly as possible. An open and functioning healthcare facility attends to the obvious health needs of a population, but it also provides the community with a sense of stability and security; a functioning hospital is a visible reminder

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within an affected community that some degree of normalcy remains. To sustain and to intensify their operations in the wake of emergencies and disasters, healthcare facilities depend on the continued operability of the physical infrastructure, the availability of requisite staff, the continuity of services from external providers, and the uninterrupted access to medical supplies.

RESILIENCE

Preventing a crisis — rather than responding after a crisis has occurred — is the ideal. Unfortunately, this is not always possible. To achieve optimal outcomes from response and recovery efforts, the concept of resilience of a healthcare system must be incorporated into disaster planning.

Resilience can be defined as the “ability to recover quickly from illness, change, or misfortune”.¹ The degree of vulnerability that a society has to any hazardous event depends upon the resilience of that society. Resilience can be considered the counterbalance of vulnerability; increasing resilience results in decreased vulnerability.

The resilience of a healthcare system has been referred to as the “...capability to effectively absorb, respond to, and recover from an internally or externally induced set of extraordinary demands”.² A healthcare facility that is resilient can decrease its vulnerability to damage from a catastrophic event, and maintain at least some level of function after the event. This level of function may be one of being fully operational, or some variation thereof — a status often referred to as the “new normal”.

A variety of factors contribute to a healthcare facility’s resilience. Perhaps the most important component in achieving resilience is planning. The anticipation of catastrophic events and knowledge of the actions required to buffer the effects of a given event at all levels, allow decision-makers to formulate and execute “what if” situations without the life-threatening circumstances that coincide with real disasters. A resilient healthcare facility results from well-executed readiness precautions and sound preparedness strategies. Formulating and executing preparedness plans through drills and exercises are invaluable components in developing resilience.

Achieving a resilient and sustainable facility, despite the effects of a long-term disaster, involves capacity building. *Capacity building* addresses issues such as supplies and staffing, maintaining essential links to community resources, and developing plans to deal with unlikely but potential events, i.e., “worst case scenarios”.

BUFFERING CAPACITY

Sundnes and Birnbaum define buffering capacity as “the ability of a society or system to minimize the change in function for a given change in available

resources”.³ The building of buffering capacity specific to health care — also referred to as “surge capacity” — has been defined as “the actions taken at the healthcare facility level that augment services within the emergency response structure of the healthcare facility”.⁴ Facility-based surge capacity is the ability of the healthcare facility to expand and extend its operations to provide adequate care to an unusually large number of patients in the event of disaster.

Surge, or the increase in patient volume, can occur immediately following a hazardous event, such as a bombing, or can develop more gradually and extend for long periods, such as would occur with a pandemic event. The resilience of a healthcare facility during a long-term event is a tremendous challenge that requires dedication and commitment from staff in addition to planning and preparedness measures.

In an effort to increase the healthcare system’s surge capacity, the US Health Resources and Services Administration (HRSA) began issuing federal grants to hospitals in 2002; now, these grants are continued by the Office of the Assistant Secretary for Preparedness and Response. In addition, HRSA has defined the surge capacity requirements for a region as the ability to treat and stabilize the following numbers of patients/one million population:⁵

- 500 patients in infectious disease events;
- 50 patients in chemical toxicity events;
- 50 patients in blast or burn events; and
- 50 patients in radiological events.

Although these patient numbers serve as a standard for preparedness measures, their validity is uncertain as the scientific methods used to obtain these numbers are not clear.⁶ The Israeli Ministry of Health defines a hospital’s necessary surge ability to be 20% above its baseline level, although this number also is not evidence-based.⁶

As a result of these mandated standards, some progress in hospital disaster management capabilities has been achieved. For example, in 2006, 86% of US hospitals reported involvement in large-scale drills and the establishment of close communications with key local and regional stakeholders (community hospitals, police, emergency medical services, American Red Cross, etc.).⁷ However, there still is much that must be done to improve surge capacity. One study of Australasian hospitals found that they do not meet the US HRSA standard benchmarks, with potentially 59–81% of critical patients not having immediate access to surgical theatres.⁸

Buildings of healthcare facility buffering capacity includes the process of disaster preparedness achieved through the development of strategies and procedures for increasing and strengthening needed resources to cope with potential patient surges. The critical components of this process often are

referred to as the “four Ss”, referring to personnel (Staff), supplies and equipment (Stuff), facilities (Structure), and a management system (System).^{6,9,10} The management system utilized throughout the phases of a disaster is the Hospital Incident Command System.

Facilities

With hospitals already operating at capacity levels on a normal day, the ability to find space for a disaster-related surge of patients requires creative thinking to identify potential spaces for expansion, and regional planning to identify and utilize nearby assets.

Bed surge expansion begins with internal expansion options, i.e., those measures that permit the reconfiguration of existing space into patient care areas and options that facilitate the removal of stable patients from the existing treatment areas. Strategies to increase hospital bed surge capacity include the:⁷

- Rapid discharge of ED ambulatory patients;
- Cancellation of elective procedures and admissions;
- Reduction of the routine use of ancillary services (e.g., x-rays, laboratory testing);
- Acceptance of admitted patients from the ED into “hallway” beds;
- Early discharge of stable inpatients;
- Expansion of critical care capacity (moving stable patients requiring ventilator support to monitored or step-down beds);
- Conversion of private rooms to double occupancy; and
- Utilization of non-patient care areas (lobbies, classrooms, etc.) for patient care.

These internal efforts at bed expansion can be coupled with external expansion options, if internal strategies are insufficient. External expansion generally involves regional planning or response as few hospitals have the financial resources to independently prepare and equip their own external surge facility. External expansion options include the use of shuttered hospitals, alternate care sites, temporary external shelters, the transfer of patients, clinics, and home care.

Shuttered Hospitals

Shuttered hospitals are closed hospitals within the community that are re-opened to help care for the surge of patients. Planning is crucial for the use of these “shuttered” hospitals as issues such as the facility’s current environmental safety will need to be addressed. Authorities in Toronto, Canada, utilized a shuttered tuberculosis hospital to care for patients infected with the Severe Acute Respiratory Syndrome (SARS) in 2003.¹¹

Alternate Care Sites

Alternate care sites include any building(s) that can be adapted to care for patients, including sports arenas, convention centers, schools, airports, warehouses, and hotels; the Joint Commission of Accreditation of Healthcare Organizations categorizes these as “facilities of opportunity”.¹⁰ During the 2005 London bombing, some patients were treated and discharged at a nearby hotel. During Hurricanes Katrina and Rita responses in the United States, both the Houston Astrodome and the Dallas Convention Center were set up to receive patients, permitting the treatment of approximately 9,000 patients each over a two-week period.¹⁰ Even a veterinary hospital was converted into a special needs shelter for 320 patients after it was emptied of animals, cleaned, and sterilized.¹⁰

Temporary External Shelters

Tents or mobile trailers can be set up and made operational fairly quickly. Resources for such shelters vary; they may be owned by the hospital itself or provided by local, regional, or federal groups. These mobile medical facilities have the advantage of rapid placement and, unlike a fixed-location alternate care site, their location can be flexible based on the specific community needs at the time.

Patient Transfer

In patients can be transferred out of hospitals within the heavily impacted region to other hospitals within the state, province, region, or nation in order to free local bed space for the surge of disaster-affected patients. Stable patients may be transferred to free-up local resources for more critical patients, or critical patients who require care that currently is unavailable at the surging hospitals may be transferred to other facilities.

Home or Clinic Care

Based on the event, public health authorities may instruct patients to stay at home for their care, arranging home delivery of essential equipment and medication, such as antibiotics in case of a biological event. Patients also may be instructed to proceed to clinic locations rather than the hospitals for evaluation, as occurred in both Toronto and Taiwan with the establishment of community fever clinics in response to the SARS event.¹¹

Staffing

With healthcare systems already struggling to provide adequate patient coverage on a daily basis, potential staffing shortages during a disaster are serious challenges in improving healthcare resilience. Without adequate staffing, the

amount of supplies available for patient care is of little consequence. In the United States, in 2007, there were 116,000 unfilled nursing positions.¹² This number is predicted to increase in the years to come. Ninety percent of long-term care facilities lack sufficient nursing staff to provide even basic aspects of care.¹³ Numerous other shortages of critical and auxiliary healthcare personnel exist nationwide.¹³

Surge Staff Capacity

Various factors must be considered when planning for “surge staff capacity”. First, each type of disaster demands specific emergency response personnel assignments. For example, a bomb explosion resulting in multiple victims with penetrating injuries will require expansion of the surgical care staff, while a large-scale influenza epidemic will call for the mobilization of pulmonary and critical care personnel. Second, different disasters result in differing emergency response timelines. For example, a building collapse can instantaneously produce a large number of victims that may overwhelm EDs within several hours; however, within 24 hours, the influx of patients typically returns to normal, pre-event levels (a static event). In contrast, a smallpox outbreak may develop slowly providing healthcare facilities sufficient time to generate the required workforce; however, in this instance, the “surge staff capacity” will need to be maintained over a long period of time (a dynamic event).¹⁴

When determining its disaster staffing policy, hospital administration must consider both the physical and psychological burdens that a disaster may place on the personnel. In the event of an influenza pandemic, it is estimated that 50% of the hospital workforce may not report to work because of illness, competing family responsibilities, or fear.^{15,16} The willingness of the staff to report to their duties following a hypothetical, unconventional missile attack was determined in a state-wide survey of Israeli healthcare workers, with only 42% of the responding staff willing to report under the presented scenario; however, the number would increase to 86% if safety measures were provided.¹⁷ Additionally, a certain percentage of staff members may have supplemental responsibilities at other hospitals or volunteer organizations, and their presence during a disaster response cannot be guaranteed.¹⁸

In order to maximize the “surge staff capacity”, hospital administration must be prepared to provide adequate safety measures and family support for the emergency response personnel. Concerns regarding these two major issues have been documented in several studies addressing nurses’ disaster response issues. Meeting the personal needs of staff is essential to increasing the likelihood of them fulfilling their professional responsibilities and duties. For example, emergency childcare facilities should be provided for the children of essential hospital workers. Safety measures to protect the healthcare

personnel must be in place and include not only adequate supplies, e.g., respiratory masks and other protective equipment, but also measures such as staff education on the effectiveness of the protective devices and procedures to ensure that staff feel safe. Safety also can be provided by allowing some departments (such as Accounting, Payroll, and Information Technology), to work from home and ensuring home Internet connections and employee accessibility to needed hospital software programs. Additional staff needs to address include housing, food, clothing, pet care, vaccine prophylaxis, mental health services, transportation, and sanitation.

To expand the staff at the onset of a disaster, healthcare administrators initially may try to maximize the use of current personnel. Staff work hours may need to be extended from eight-hour shifts to 12-hour shifts during an emergency response. Off-duty personnel and non-clinical staff (such as nursing supervisors/managers, research nurses, and quality improvement coordinators), may be placed in clinical roles based on their skills and qualifications. In addition, non-emergency healthcare personnel (staff from hospital clinics and healthcare offices) may be used in emergency response assignments. Protocols for such actions must be described in advance by hospital administrations.

Another staffing option is based on a tiered method, which involves cross-training nurses to provide care at another, usually higher, level of care. For example, clinic nurses may be cross-trained as nursing home or shelter nurses, emergency room nurses may be cross-trained as intensive care nurses, and intensive care nurses may be cross-trained as burn nurses. This cross-training

INTERNAL ACTIONS	REGIONAL ACTIONS	NATIONAL RESOURCES
Increase duration of shifts (12 hours) Adjust staffing ratios Recall off-duty personnel Reassign non-clinical staff (nursing supervisors, research nurses, etc.) Utilize non-emergency personnel (from hospital clinics, medical offices, etc.) Solicit volunteers (retirees, former employees, etc.) Cross-train nursing staff Provide safety measures (masks, gloves, vaccine prophylaxis, etc.) Provide staff support (child care, food, transportation, etc.)	Establish working relationships with stakeholders: ➤ Regional hospitals ➤ Medical offices ➤ Clinics ➤ Medical/Nursing schools Activate a memoranda of understanding (MOU) with: ➤ Local and regional hospitals ➤ Health systems ➤ State disaster medical assistance teams	Medical Reserve Corps National Disaster Medical System Public Health Service Commissioned Corps Disaster Medical Assistance Teams Volunteer agencies and organizations (e.g., American Red Cross) Volunteers registered through ESAR-VHP Temporary medical staffing agencies

Table 8.1: Strategies to increase hospital staff capacity (ESAR-VHP = Emergency System for Advanced Registration of Volunteer Health Professionals)

provides flexibility during disaster response as the healthcare needs vary among disasters and even vary over time during the same disaster.

Another staffing strategy involves creating partnerships between local and regional healthcare facilities to ensure resource sharing in the event of a disaster. Non-affected hospitals would have agreements to send personnel to supplement those hospitals that are being heavily impacted by arriving victims. In addition to local hospitals, assistance can be requested from other states/provinces. In the United States, the National Emergency Management Assistance Compact (EMAC) allows the sharing of personnel and other critical resources between states during emergencies and disasters.¹⁹ During Hurricanes Katrina and Rita, the EMAC deployed 31,000 workers to Louisiana and Mississippi.¹⁰ Table 8.1 outlines various strategies to increase hospital staff capacity at local, regional, and national levels.

Volunteers

Despite efforts to rearrange staffing patterns and to supplement staffing from outside healthcare facilities, supplemental personnel from volunteer agencies or pools often are needed, particularly in events of large magnitude or long duration. The Medical Reserve Corps (MRC) is a national US program that organizes and trains groups of volunteers at the community level to respond during times of emergencies and disasters.²⁰ Currently, the MRC organizes approximately 173,000 healthcare volunteers.²⁰

In addition to the MRC, US healthcare organizations may use several other resources for the recruitment of healthcare emergency personnel. The National Disaster Medical System (NDMS) is designed to assist communities with the healthcare impacts of major disasters, with 7,000 available physicians, nurses, dentists, pharmacists, and other specialists.^{10,21} Another source of healthcare personnel is the US Public Health Service Commissioned Corps, with approximately 6,000 healthcare professionals that can be called upon during national emergencies.^{10,22} Other resources for staffing include the local Red Cross, healthcare staffing agencies, and local healthcare academic institutions.

VOLUNTEER POOL OPTIONS:¹⁰

- Utilize retired healthcare providers;
- Expand pool of potential providers to include dentists, pharmacists, and veterinarians;
- Utilize local medical and nursing school students;
- Re-assign non-emergency care providers into emergency roles;
- Utilize non-medical community members to assist medical response; and
- Provide national credentialing and liability coverage.

Credentialing and Liability

Liability concerns may cause hospitals to be unwilling to utilize healthcare volunteers unless they are assured that these volunteers are appropriately qualified.²³ During a crisis, it can be time consuming and labor intensive for healthcare facility personnel to verify credentials (e.g., boards of nursing, state medical boards, the Office of the Inspector General, current credentialing hospital, etc.) and to determine the competency levels of a large number of volunteers. For example, following the 1994 Northridge, California earthquake, one hospital was forced to utilize many healthcare volunteers; the process of emergency credentialing became so cumbersome that the effort was abandoned.²⁴

Within the US, efforts to simplify the credentialing system for hospitals at the time of an emergency resulted in the creation of the Emergency System for Advanced Registration of Volunteer Health Professionals (ESAR-VHP), a state-based system that provides verifiable, updated information about the identity, licensing, and credentials of willing volunteers. Subsequently, the information from all states has been compiled, creating a national database of potential healthcare volunteers.^{25,26} In the event of an emergency declaration, the database of pre-screened volunteer professionals becomes available to all involved surging hospitals. Although several US states have successfully implemented this program, its ultimate utility is yet to be determined.²⁷

An important consideration for healthcare volunteer professionals is legal liability protection. In the United States, legal coverage from state to state varies; some states provide coverage for Tort Claims, Worker's Compensation, and Good Samaritan laws, while others do not. Also, some volunteers may be covered under the US Volunteer Protection Act of 1997,²⁸ which protects volunteer clinicians working in nonprofit organizations from lawsuits for simple negligence.¹⁷ In the aftermath of Hurricane Katrina, the US Department of Health and Human Services provided liability protection to healthcare volunteers as unpaid federal employees. Currently, in the United States, there is no legislation in place to protect surge hospitals from civil liability.

Equipment and Pharmaceuticals

An essential component of an effective hospital surge capacity is ensuring that sufficient equipment and pharmaceuticals are on hand. However, widespread financial struggles experienced by the healthcare sector make it difficult for healthcare facilities to meet this need. In 2006, 27% of US healthcare facilities operated at a deficit.⁷ In order to cut costs, most facilities operate on a "just-in-time" re-supply system, having on hand only what is needed for the current plan of operation.²⁹ This is considered to be a sound fiscal practice during normal operations, but during a disaster, "just-in-time" supplies are inadequate to address the increased demand.

Maintaining emergency stockpiles within a healthcare facility is burdensome because of both financial and physical limitations. The US Strategic National Stockpile (SNS) is a program sponsored by the Centers for Disease Control and Prevention (CDC) and contains medications, vaccines, and other healthcare supplies and equipment to be used in the event of an emergency.³⁰ These resources are delivered to states and, subsequently, to regions involved in the disaster response. Although the SNS's goal is delivery anywhere within the United States within 12 hours, the entire process from the time of the request until physical delivery and distribution may take up to 36 hours. Following Hurricane Katrina, surge hospitals in Louisiana waited several days before SNS supplies arrived.¹⁰ Thus, in the initial stages of disaster response, hospitals must rely on their own, on-site inventories to deliver essential healthcare services.

Other options for surging hospitals include the requisitioning of healthcare supplies from other non-impacted local and regional healthcare facilities, medical schools, medical supply companies, physician offices, and medical schools.¹⁰ The importance of close, pre-established relationships with these organizations cannot be over-emphasized. Identifying and categorizing which supplies would be available within the community, identifying contact personnel, and obtaining contact information prior to a disaster will facilitate the acquisition of these supplies. Hospitals also should determine how readily vendors can deliver supplies after an unscheduled request and even incorporate the request and delivery process into disaster drills. Relationships with multiple suppliers also may accelerate the procurement of supplies in an emergency.

Some states create strategic stockpiles through vendor-managed inventory, whereby a vendor maintains a certain quantity of pharmaceuticals for use by the state in an emergency.³¹ The supplies are stored for a certain period of time and, if not used, they are released into the general circulation. Also, some hospitals have established emergency shipment protocols with vendors so that in the event of a disaster, a vendor would immediately begin shipping critical resources to reduce delays in receiving the receipt of needed supplies and equipment in an affected area.²¹

LIFELINES

Beyond staffing and medical supplies, healthcare facilities are vulnerable through potential interruption of needed infrastructure support systems, such as electricity, fuel, communication, water, food, and sanitation. These are referred to as “lifelines”, as they are mandatory connections with the community that provide resources necessary to maintain operation of the healthcare facility. Failure of one system may affect others. For example, without water there is no sanitation; without power there is disruption of telecommunications, air conditioning and heating systems, computers, and other healthcare

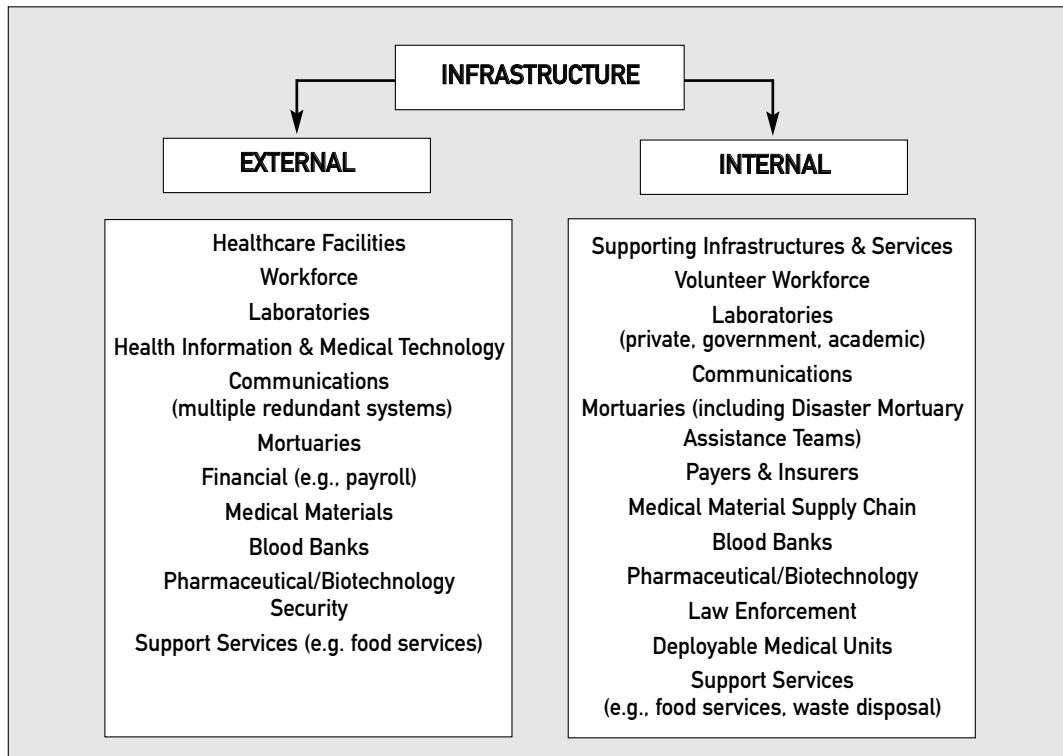


Figure 8.1: External and internal components of healthcare facility's infrastructure

Created by R. Lavin & M. Pekarev

equipment (Figure 8.1). Disaster preparedness must include mitigation and planning efforts to limit the risk of failure of one of these critical systems, and to increase the healthcare facility's resilience during a disaster.

Electricity and Fuel

Power outages frequently are associated with earthquakes, tsunamis, hurricanes, tornadoes, and floods. Sustained power loss will force a hospital evacuation; provisions must be in place for back-up sources of power, e.g., emergency generators. In 2004, Hurricane Charley struck the western coast of Florida, the United States, causing a power outage in one of the regional healthcare centers. Although emergency power generators were activated, the healthcare center ran out of fuel within 28 hours of operation. As a result, patients had to be evacuated to nearby hospitals.³² Both a sufficient amount of fuel and arrangements with an outside vendor for back-up supplies should be in place prior to a disaster.

The Joint Commission on Accreditation of Healthcare Organizations mandates that back-up emergency power must be sufficient to supply alarm systems, exit signs, emergency communications systems, emergency/urgent care areas, operating rooms, at least one elevator for non-ambulatory patients, obstetric rooms, newborn nurseries, and medical gas and vacuum systems.³³

In addition, hospital administrators must consider fortifying the structure of electrical housing areas in order to make them less vulnerable to strong ground motion during earthquakes. Generators should not be located in the basement or in low-lying areas of the facility due to the potential for damage from flooding with resultant failure of the generators.

Planning should include the provision of battery-powered equipment for patient care, the distribution of flashlights and batteries to staff, and the priority care of patients on ventilators. Key maintenance personnel, e.g., electricians, must simulate their potential role during drills and respond to facilitate repairs in the event of a disaster.

Communications

A failure of communications can occur from damage or from the overloading of either internal or external healthcare facility communication systems, or both. The loss of communication shuts the hospital off from the outside world, including response agencies, and further complicates the hospital's ability to obtain appropriate support. Internally, the loss of communication adversely affects the coordination of the disaster response and patient care as individual departments and incident command members cannot readily exchange information. During Hurricane Katrina, flooding, structural damage, and electrical power outages incapacitated hospitals in downtown New Orleans, forcing staff to deal with complete failure of communications, including cell telephones, landlines, television, Internet, and e-mail. One hospital worker recalled, "We were unable to communicate with local police, the National Guard, the Federal Emergency Management Agency, or even between and within buildings of our own institution."³⁴

To prevent a communication breakdown during a disaster, healthcare facilities must have effective, collaborative interdisciplinary and intergovernmental planning for interoperable communications.³⁵ This requires that healthcare systems be included when local emergency management or the Ministry of Health plan local and regional communication systems to ensure that hospitals obtain the necessary devices to communicate with needed governmental agencies, first responders, and other healthcare agencies, e.g., public health agencies and other hospitals. There also must be redundant communication systems, i.e., more than one way to communicate, in the event that one system fails. Satellite phones, two-way radios, paging systems, and analog telephones lines can be used as redundant communications systems. Additionally, healthcare facilities should have agreements with local telephone companies to prioritize hospital repairs during an emergency.

Water

Healthcare facilities must have plans in place for the potential occurrence of water

shortage or contamination caused by external events (flooding, sewage contamination) or internal events (water system breaks). The facility's total need for potable water for a minimum of 24–48 hours must be determined. Water supply sufficient to cover this predetermined demand should be maintained through supplies of bottled water or on-site storage tanks. For example, in one African hospital, emergency water storage was maintained in large steel tanks placed on the roof, using gravity to provide water flow throughout the hospital when needed.³⁶ In this situation, the water supply to the hospital was maintained, even during an electrical outage. Other facilities may rely on on-site wells that can be used in the event of water shortage. Most hospitals establish agreements with local retailers or certified water suppliers to deliver a predetermined quantity of bottled or bulk water, in the event of a shortage. However, this relies on the accessibility of the facility to outside deliveries, which is not the case in many disasters.

Food

Planning for food shortages during a disaster is important to ensure adequate nutrition of patients as well as staff. Additionally, if the disaster is of a large scale, the healthcare facility may find itself viewed as a place of safety with citizens flocking to it for refuge; these people will need to be cared for as well. Hospitals need to estimate the quantity of food required for basic sustenance for at least a three-day period. A stock of non-perishable items, as well as materials used for parental nutrition, must be maintained at all times by healthcare facilities. Food services personnel also should be considered as essential staff for adequate “surge staff capacity”.³⁷ Nutritionists should work with the staff to determine alternate feeding plans for times when there is no, or limited, power and water; these plans may include use of an outside vendor, utilization of non-perishable items, or support from local volunteer organizations.

CONTINGENCY PLANNING

Although disaster events have certain common characteristics, they all present numerous, unpredictable challenges. Contingency planning in disaster preparedness is the development of specific plans for the occurrence of differing hazardous events. For instance, preparedness planning for pandemic events would require stocking large numbers of respiratory masks, whereas planning for a power loss would not require this. However, planning for every contingency, no matter how unlikely, would be time-consuming, financially unfeasible and, most importantly, inefficient. Thus, an “all-hazards” approach should be incorporated, as much as possible, throughout the various contingencies. All-hazard planning involves a centralized disaster plan based on the commonalities that exist among the various disasters, rather than having a completely different plan for every single type of potential disaster or operational failure. This approach limits staff confusion and

increases operational efficiency as the planned disaster response is performed the same way, regardless of the cause; supplemental information relating to the specific issues of a particular disaster is provided separately.

The World Health Organization (WHO) identifies the following steps for contingency planning:

1. Identify likely scenarios;
2. Set priorities and goals;
3. Identify activities and tasks;
4. Allocate resources;
5. Allocate responsibilities;
6. Set the order of implementation;
7. Ensure technical inputs; and
8. Develop procedures.³⁸

Planning, in conjunction with education and practice, results in a knowledgeable, versatile, and resilient healthcare staff equipped to deal with the worst-case scenarios. For example, in the spring of 1997 in Winnipeg, Canada, St. Boniface General Hospital was severely flooded. As part of its response, the hospital staff was divided into two groups. The first group provided patient care and evacuation, while the second group concentrated on flood control measures, including relocating assets (such as computers, equipment, and patient files) to areas of the hospital that remained dry.³⁹ The resilience as well as the leadership of the hospital staff during this unexpected event established structure and prevented a disaster from occurring.

SCARCE RESOURCES

Healthcare facilities must realize that, regardless of the degree of planning, critical resources may become scarce or deficient during an emergency or disaster. In this case, prioritizing often serves as the only viable strategy to manage these limited resources. Understanding the practical and ethical consequences of this strategy becomes the responsibility of all healthcare professionals, governing bodies, and the public.

Priority Setting

“Priority setting”, or rationing, refers to the hierarchical process of prioritizing the distribution of critical resources to recipients when resources become limited and the demand for certain resources rises.⁴⁰

In an ideal, peaceful setting, healthcare professionals direct their efforts towards maximizing benefit and preventing, avoiding, or eliminating harm when treating a patient. This principle of beneficence serves as the foundation upon which healthcare is based.⁴¹ All available resources are used to provide the highest level of care possible to an individual in need.

However, during massive catastrophes, allocation of resources and human efforts must be directed toward providing the greatest good for the greatest number of people.⁴¹ This shift in paradigm does not imply that the principle of beneficence be ignored; rather, that the principle of maximizing utility must be considered and emphasized.

The ability to stratify patient populations into specific categories of care, also known as triage, is crucial to resource rationing, and comes into play even in peaceful times. For example, at a given time, a hospital may have three patients requiring emergent or urgent surgery with only one surgeon available; or 12 patients may require intensive care, but only 10 intensive care unit beds are available. Therefore, it is a common practice among healthcare providers to stratify patients based on the severity of their disease, deciding who requires the intervention more urgently.⁴²

In a disaster situation, patient stratification begins at the onset of the disaster and continues for days, weeks, and even months thereafter. Nurses must have the ability to categorize victims into a proper category of care, such as critical, guarded, or stable. Healthcare personnel must be able to adapt to meet the health needs of the impacted community as new and unforeseen challenges arise. As the resources become further limited, stringent stratification systems may need to be implemented to ensure that the greatest good is provided to the greatest number of people. For example, one potentially life-saving resource that healthcare facilities utilize during a disaster response is blood and/or blood products. Initially, blood may be available for all victims in need; however, if the blood supply becomes limited, clinicians may be forced to become highly selective about the use of this limited product and transfuse only the most critically injured patients. Finally, when the availability of blood products reaches a critically low point, transfusions may be given only to those patients with the best survival probability. This allocation of scarce resources can apply to numerous and varied resources, such as antibiotics, ventilators, and vaccines.

Altered Practices of Care

Altered practices of care refer to the changes in the normal delivery of care due to the need to allocate scarce resources, or because of the exhaustion of existing resources. Altered practices of care also are referred to as providing “austere care” or a “sufficiency of care.”⁴³ Effective pre-event planning will assist in increasing the surge capacity of a hospital, a region, or a country. However, it is a false assumption to believe that an entity is so well-prepared that alterations in the usual delivery of care will never have to be considered; a catastrophic event could require even the most prepared healthcare system to reallocate resources.⁴³ The goal is to provide as high a level of care as the current conditions allow. This may mean that only basic healthcare needs are provided at the surge hospital, and that patients are

transferred to regional hospitals for more advanced medical care.¹⁰ Or patients may be triaged to prioritize use of what limited, sophisticated care still may be available. Regardless of the method chosen to allocate scarce resources, healthcare leaders must plan their strategies in advance, with specific guidelines for nurse clinicians, so that there is a medical, legal, and ethical framework pre-established for the difficult decisions that must be made rapidly at the time of the event.

Although planning for all potential shortages and contingencies is impossible, nurses needing to make ad hoc adjustments in care can be assisted in the process through carefully pre-established guidelines. In planning altered practice guidelines, healthcare facility leaders should assess their resource vulnerabilities, review which procedures and plans are in place to augment those resources during a disaster event, and plan for specific criteria or trigger points that guide when to implement altered practices of care. One method is the development of a Patient Prioritization Matrix, which allows the clinician to quickly input information related to the size of the surge and available resources and, from pre-determined parameters, determine the prioritization that needs to occur.⁴⁴ A clearly communicated message to the public on how resources will be allocated in times of scarcity is critical to maintaining public calm and trust.

PUBLIC RELATIONS

Regardless of the type or the magnitude of a disaster, communication is an important avenue for conveying timely and accurate information to the public. The Public Information Officer of the healthcare facility's ICS should disseminate the information regarding risks and associated uncertainties. In addition, they can provide assistance in reuniting loved ones.

Within the healthcare facility, the Public Information Officer should have specific plans to deal with the arriving media and families searching for loved ones. Establishing both one central spokesperson and one centralized location for providing communication updates will help to ensure consistent and appropriate communication.

Effective communication can help quell a community's psychological instability following a crisis. Through the ICS, healthcare facilities should communicate and provide information to a variety of groups during a disaster, including displaced families searching for loved ones, hospital patients concerned about their friends and family, hospital workers and their families, the community at large, and the media.

Disaster Information Centers

Disaster Information Centers collect and provide information of the individuals residing within the disaster-impacted area to immediate family members outside of the affected region. In the event of a federally declared disaster, a

Disaster Information Center may be established under the National Response Plan. This system of communication may help facilitate the reunification of family members within the affected area.⁴⁵

Reunification

To help maintain psychological stability in a community after a disaster-producing event, it is essential to reunite relatives with their loved ones, especially children and special needs populations. After the tsunami in Indonesia, the UN's Children's Fund (UNICEF), the Indonesian government, and international, non-governmental organizations registered missing children and provided psychological and emotional support to those who still were searching for their families. The process included identifying separated and unaccompanied children in an effort to reunite them with their family members. For those who were unable to be reunited, UNICEF initiated a fostering program to smooth the transition of these children back into their communities.⁴⁶

Other domestic programs also have successfully reunited family members after disasters. Since 1905, the American Red Cross has participated in international family tracing and message delivery services to link families torn apart by wars and international conflicts.⁴⁷ During Hurricanes Katrina and Rita in the United States, the National Center for Missing and Exploited Children (NCMEC) played an influential role in reuniting lost children with their caregivers. The NCMEC, in collaboration with Project ALERT and Team Adam, created a new child-locator hotline specific to the hurricanes by conducting analytical and investigative work, and developing innovative search techniques. In the end, the NCMEC's efforts successfully reunited 5,000 lost children with their caregivers.⁴⁸

STAFFING AND SUPPLIES AT A NEW YORK CITY HOSPITAL ON 9/11

On 11 September 2001, at 10:30 am, St. Vincent's Hospital in Manhattan, New York, received the first victim from Ground Zero (the site of the terrorist event). By noon of that same day, hospital staff had obtained a two-week supply of supplemental equipment, including 25 ventilators and 300 oxygen tanks. Because the initial expectations included receiving large numbers of burn patients, they also received 7,500 burn packs and 18,000 burn linens.⁴⁹ Hospital staff interacted early with medical supply vendors and the New York City Police Department to ensure that the supplies could, in fact, reach the hospital. Potential staffing needs were addressed by creating available staffing pools of 300 physicians, 100 nurses, and 500 other hospital workers, as well as >400 individuals who called to volunteer their services. Unfortunately, there were few survivors of this incident who could benefit from this hospital's surge preparedness.

Robert Powers

CONCLUSION

Emergency response planning is a tremendous challenge that all healthcare facilities must face. All disasters have predictable, as well as unpredictable, effects. For those hazardous events with a high probability of occurrence, healthcare facilities must develop detailed protocols and plans to increase their resilience and reduce their vulnerability to the effects of the event. Adequate, long-term sustainability can be enhanced through preparation and attention to the objectives reviewed in this chapter. In summary:

1. Resilient healthcare facilities must know the potential threats in their community and plan for the physical, biological, psychosocial, and cultural demands that will follow such an event;
2. Healthcare facilities must come together as a community and plan for capacity building, including bed space, supplies, and staff;
3. Healthcare facilities must have a staff surge capacity plan that incorporates alterations in staffing schedules, a tiered approach to staffing, and the use of volunteers;
4. Effective methods of credentialing healthcare volunteers must be in place in advance of a disaster;
5. Healthcare facilities must have a medical supply chain re-supply or reallocation plan that includes agreements with other local facilities and suppliers;
6. Healthcare facilities must know how to request national and regional stockpiles that have been established to provide medical supplies in times of emergency;
7. Healthcare facilities must have plans for the reallocation of bed space, including triaging, delaying elective procedures, and the use of alternate care facilities;
8. Healthcare facilities' infrastructure must be protected, vulnerabilities must be identified and, to the extent possible, eliminated;
9. Supporting facilities and partners must be known in advance of a disaster; and
10. Planning, training, and exercises must become part of the healthcare culture.

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CHAPTER 9

HOSPITAL IMPACT: INTERNAL DISASTERS

Theo J. Lighthelm

HEALTHCARE FACILITIES, generally, are perceived to be safe areas in which optimal care is provided and patients are accommodated in a supportive environment. However, the ability to function can be disrupted easily by various events (such as fire, loss of electrical power or water, hurricanes, or earthquakes), that cause either direct damage to the facility or severely disrupt essential services and impact the facility's ability to provide health care to the community.

OBJECTIVES:

- Describe the various potential causes of an internal disaster in a hospital;
- Describe the essential emergency actions during a hospital evacuation; and
- Understand the differences between a planned and unplanned disruption in essential hospital systems.

Hospital preparedness plans typically address the hospital's responses to external emergencies that result in a surge of patients to its facility. However, it is equally important that healthcare professionals are trained to implement emergency measures effectively and immediately during internal events in order to protect the well-being of both patients and fellow staff members. Hospital response plans for internal disasters must be developed and tested to ensure their familiarity by all staff and should be an integral part of emergency management plans.¹

INTERNAL DISASTER

An internal disaster refers to an event-related disruption of the effective functioning of the healthcare facility that requires extraordinary actions, and

endangers the safety of patients, visitors, and/or staff. The event may not necessarily be internally caused, but can be internally disruptive.²

Healthcare facilities must perform a thorough analysis to identify the most likely incidents that could disrupt the functioning of their specific facility. Based on the identified risks, action plans must be developed to address the counter-measures needed to mitigate or prevent such incidents. These action plans must be practiced regularly through drills and exercises, or they become only a paper plan that often is not even consulted in an actual crisis.²

The overall goals of planning for an internal disaster are to:

- Protect patients, visitors, and staff from harm;
- Provide safe evacuation of patients, visitors, and staff, if needed;
- Isolate/contain the problem(s); and
- Maintain patient care.³

PLANNING AND SAFETY COMMITTEE

To ensure effective planning for various internal risks that may occur within a healthcare facility, it is essential that a formal planning group be established to coordinate, formalise, and approve all planning. Such a committee often is referred to as a Disaster Committee or a Major Incident Committee, depending on the legislation and practice in a specific country.

As an internal major incident may have catastrophic results for a healthcare facility, it is essential that the departmental representatives on the Planning and Safety Committee have an appropriate level of authority to approve formal decisions. The coordination and formal approval of all plans must be sanctioned at the highest level of the institution. Often the committee functions under the leadership of the Chief Executive Officer of the facility or his/her deputy.

The Planning and Safety Committee may form part of the structured Occupational Health and Safety system prescribed in many countries. If this is not the case, the chairperson of the Occupational Health and Safety Committee must be represented on the Disaster or Major Incident Committee. Other members should include departmental heads, maintenance staff, safety and security staff, and the In-service Training Coordinator of the institution. External role-players (including the local fire brigade, police service, emergency medical or ambulance service, air evacuation service, rescue services, and local utility services providing electricity and water to the facility) also should be co-opted to the Planning and Safety Committee.

It has been demonstrated to be beneficial for the chairpersons of the various healthcare facilities in a region or city to collectively form a Planning Group to ensure that a liaison exists between facilities to support one another in a major incident.

INCIDENT COMMAND

To manage an internal disaster, it is essential that effective, visible command be established and identified publicly. Based on the nature of the internal disaster, response often is accomplished through the use of an expandable Incident Command System structure with various building blocks added, such as Hospital Command, Fire Command, Emergency Medical Service Command, Police/Security elements for crowd control, and Local Authority Command to address infrastructure support. (See Chapter 10 for a detailed discussion of the Incident Command System.)

The facility's maintenance personnel control the technical functioning of the vast number of systems that keep the facility functioning. In certain healthcare systems this individual is the Hospital Engineer or Technical Manager. This individual plays an important role in all disaster response actions, but is critical during an internal disaster.

Often, various experts among the facility's staff are co-opted to the Command Group in an internal disaster to advise on issues within their areas of expertise, such as the expert on the medical gas supply and piping, and the electrical engineer with expert knowledge of the emergency power supplies. To manage an internal disaster, the Incident Commander also must have access to all available planning data, including detailed plans of all areas of the complex, and capacity information of essential components such as oxygen tanks and water tanks.

Depending on the nature and complexity of the incident, various external agencies will be activated to support the facility in the event of an internal disaster. The commanders of these various agencies will join the facility's Command Group, and, with the Incident Commander, jointly assume a unified command of the incident. Examples of these external agencies include the:

- Fire Brigade or Department;
- Emergency Medical and Ambulance Service;
- Disaster Management Agency;
- Volunteer organizations;
- Military Medical Service;
- Public Health Agency; and
- Engineers (such as structural engineers).

It must be emphasized that officials from these expert agencies do not function "under" the command of the facility's Incident Command officer, but are jointly in command of the incident under the "chairpersonship" of the Incident Commander or lead hospital executive. Each officer remains in control of his/her own particular function and resources.

If the safety of the designated hospital Command Centre is in question, it is essential that at least two planned alternative sites be available. These sites

must be in alternative buildings to accommodate the Incident Command team in events such as a hospital fire, a structural collapse, or the contamination of the facility. The location of the alternative Command Centre(s) must be known to all members of the Command Team as well as the main external agencies, such as the Fire Brigade. However, knowledge of its location must be restricted to designated role-players in order to prevent sabotage or access by unwanted elements, such as the media. It may be necessary for the Incident Command Team to assemble at a mobile command post outside the building complex in an event such as a structural collapse of the hospital complex, when none of the buildings or adjacent structures may be safe to use.

INCIDENTS

An internal disaster may be isolated to the healthcare facility only, making it relatively easy to activate support resources to address the incident; this is referred to as a *simple incident*. On the other hand, the facility may be just one site that is part of a larger disaster, making it a *compound incident*.⁴ In the latter occurrence, the healthcare facility's needs compete with others' needs for resources within the community.

Simple Incidents

In a simple internal disaster, the healthcare facility is affected while the rest of the community and infrastructures continue to function and, therefore, can support the facility. An example of a simple internal disaster is the loss of function following a major incident, such as a fire in the hospital; the hospital and its functions are dramatically affected, but all of the roads to the hospital remain accessible, the water supply is available, and health care is available at other area hospitals.

Compound Incidents

A compound incident refers to an internal disaster in which the healthcare facility is just one of many facilities and community infrastructures affected by the event. An example of a compound incident is the occurrence of a fire in a hospital after an earthquake. The hospital is damaged and unable to function because of the fire, but roads leading to and from the hospital may be obstructed by fallen debris or landslides, the water supply may be disrupted, and all electricity in the city may be cut off. Another example would be a hurricane that causes damage and loss of function in surrounding areas, including other hospitals. In both situations, relief efforts to address the hospital's disaster would be seriously compromised. Compound incidents highlight the need for hospitals to be part of preparedness plans that extend beyond their particular facility and involve the region, state, and country in their planning.

An internal disaster can be further classified as a *compensated* or *uncompensated event*. A *compensated internal disaster* is one in which the situation can be managed by mobilizing additional resources to meet the needs of the situation. An example of a *compensated internal disaster* is the dysfunction that occurs as a result of a fire in a free-standing ward of the hospital complex, to which additional, off-duty nursing staff are mobilized to evacuate patients to the other wards of the hospital, and to provide care for these patients while the fire is being extinguished by the fire brigade. Within a short period of time, and with effectively managed additional resources, the hospital is able to resume normal functioning.

An *uncompensated internal disaster* occurs when the additional resources that can be mobilized by the healthcare facility are inadequate to manage the situation. One example includes the need for the total evacuation of a hospital due to a structural collapse; irrespective of how many resources are dispatched to the scene, the facility will not be able to resume normal functioning within the near future.

SYSTEM DISRUPTIONS

Hospitals are dependent on the integrity of the community's infrastructures and, therefore, must incorporate the potential losses of essential infrastructures into their preparedness plans. Various planned and unplanned incidents can disrupt the infrastructure and, thus, the functioning of a healthcare facility and threaten the safety of patients and staff. There are several reports indicating that system disruptions (plumbing disruptions, leakage of water, etc.) rather than structural damage to the hospital, were the greatest initial patient safety concerns and the impetus to evacuate following an earthquake.^{5,6}

Planned versus Unplanned Disruptions

Often, the disruption in the functions of a facility is part of a planned action. An example of this type of incident would be major maintenance work that requires the temporary discontinuation of piped oxygen. When this is planned, the facility can activate its action plans well in advance of the disruption, and mitigate its effect on patient care by providing alternative sources of oxygen (such as cylinders) in critical areas, and/or limiting the number of patients within the facility by not performing elective procedures during this time. Normally, this situation can be managed without any major effect on the patients or their care.

When the disruption of the supply of oxygen is due to a sudden burst of the supply line from the oxygen bank to the hospital, the same actions must be taken; however, there is no lead time or preparation, and, thus, patients are placed at substantial risk.

Preparing for a Planned Disruption

As soon as information is received regarding a planned disruption in services, an assessment must be performed to determine the impact on the facility's functions. If the impact of the planned action will be substantial, the most effective mitigating factor to consider is reducing the dependency load within the facility by reducing the number of patients within the facility. Usually, this is accomplished by postponing all elective surgery and placing limitations on hospital admissions. A second option is to transfer high-dependency patients to other facilities.

It is essential that planning be as comprehensive as possible to allow for various complications that may develop during the disruption. For example, if the hospital is informed that there will be a total power outage for four hours during the installation of a new transformer, additional action plans are necessary regarding what to do if the power supply cannot be restored in four hours. Plans may need to address meals for patients, requirements for scheduled surgeries, and, possibly, the need for lights after sunset.

ESSENTIAL SYSTEMS

A healthcare facility relies on numerous supplies to keep it functioning effectively. Although a disruption in the supply of some materials may be uncomfortable, the disruption in the supply of certain essential items or utilities will disrupt totally the effective functioning of the facility, and may threaten the safety of patients. The term "utility outages" often is used to describe these situations.²

A proper risk assessment is recommended to identify the risks for supply disruptions to the facility and to compile flexible action plans that can accommodate various emergencies. Some essential supply outages include: electrical power; oxygen and medical gas supplies; steam equipment; suction systems; water systems; and sewage systems.

Electrical Power

Most modern hospitals are completely dependent on electrical power for effective and safe functioning. Although most hospitals are legally compelled to have a power back-up system, these systems often are able to supply specific, high-dependency areas only; they also can fail at a critical stage. Therefore, it is essential to compile action plans that address a complete power failure, especially over a prolonged period of time.⁷ This requires that the dependency on electricity of all units within the facility be assessed and ranked according to the determined level of dependency. This assessment must be done in collaboration with the clinical staff of the various units and can be ranked or graded using a colour-coded or numerical dependence grid, or any other easy,

understandable system. An example of one assessment dependency grid is as follows:

- *Red* — completely dependent on electrical power; loss of life could occur if not provided (e.g., an intensive care unit with electrically-driven ventilators);
- *Orange* — dependent on electricity; loss of life could occur with disruptions >10 minutes (e.g., an operating theatre where non-major procedures are performed with gas-driven anaesthetic machines);
- *Yellow* — dependent on electricity for effective functioning, but loss of life would not occur if not restored (e.g., a general care ward with post-operative patients); and
- *Green* — no dependency on electricity (e.g., an outpatient department that operates only during daytime hours and has adequate natural light).

Normally, all areas that are classified as *red* in the above classification example will have an emergency power supply. If some of these areas are not supplied, action plans must be created to be activated immediately if a power failure occurs. For example, if an intensive care unit (ICU) cannot be supplied with emergency power, bag-valve-mask units and a battery-powered flashlight must be mounted at each bed.

The Planning Group must determine the availability of back-up generators to determine the potential capacity of the system and to plan options for maintaining long-term functioning, such as refuelling and maintenance.

Oxygen and Medical Gas Supplies

Most modern healthcare facilities are dependent on the supply of oxygen and medical gases to render advanced care. A failure in the availability of these supplies to an acute care facility will cause a serious internal disaster. In areas in which patients are mechanically ventilated, alternative sources for oxygen and other medical gases must be planned. Manual ventilation using a bag-valve-mask must become the immediate action when the oxygen system fails. Additional oxygen supply must be arranged; this may include oxygen cylinders, liquid oxygen tanks, oxygen concentrators using room air, or oxygen generators using chemical processes to generate oxygen. The size, space, and maintenance requirements of these supplies prevents their placement directly next to every bed in the ICU; thus, oxygen tanks with a multi-regulator that often are used by the emergency services may be needed. A central supply of oxygen cylinders with regulators for use during an oxygen outage must be available and considered in preparedness planning. These may be on emergency trolleys or crash carts located on each floor of the facility, or part of the

equipment brought by a cardiac arrest response team. During power outages, ventilatory assistance may be provided using intermittent positive pressure breathing machines powered by oxygen instead of electricity. However, this depletes the oxygen supply faster than usual and must be considered in preparedness planning.

Steam System

Hospitals often depend on steam for sterilization, kitchen functions, and sometimes for cooling or heating systems. Older facilities in less developed areas of the world are especially dependent on steam for sterilization of medical equipment, and for cooking. Steam-operated autoclave sterilization units cannot function without an external steam supply. Sterilizing instruments using mobile, pressure cooker-type sterilization pots on a gas stove is a low-technology solution for the less developed parts of the world. The use of boiling water is an acceptable alternative for the sterilization of instruments. However, dressing materials and surgical gowns and drapes cannot be sterilized in this way, and disinfection by ironing these items often is the only available technique.

Suction System

Piped, centrally operated suction systems are essential, especially in acute care and intensive care areas. These systems often are dependent on electricity to drive the central vacuum pump(s), or they may fail as a result of mechanical defects in the system. In the event of structural damage to the hospital, pipes can be damaged resulting in the loss of negative pressure. Often, suction pumps are housed in the basement of facilities and, therefore, prone to damage from flooding.⁸ The availability of manual, preferably foot-operated, suction units in areas of high demand are recommended. Improvised suction methods using large syringes, especially bulb-type syringes, are possible.⁹ Small, mucus-extractor, mouth or bulb suction devices for newborns must be available in all obstetrical units to address a possible suction system failure.

Water System

The water supply to the healthcare facility can be disrupted for various reasons. Depending on local legislation, most hospitals are obliged to maintain an emergency water reserve as well as an alarm system indicating any disruption in the main supply, and a water reservoir containing enough water for the hospital to function for 24 hours.^{9,10} Water of various levels of purification can be brought in, depending on suppliers and sources. In developed countries, the use of bottled water is an option, while in a developing country, a water bore-hole (well) may be the only available source. Action plans must be in place for

alternative ways to provide water to the facility. If an on-site water borehole is available, the functionality of the pump, fuel for the pump, and piping are aspects to consider in planning for this contingency. Although the emphasis is placed on volume rather than purity of water, the risk of polluting the supplied water with dangerously contaminated containers must be emphasised. Basic chlorination techniques can be used to address this risk.

Sewage System

Ground movement that occurs during an earthquake can cause underground sewage lines to become kinked and blocked, resulting in a failure of sewage drainage. Keeping a modern healthcare facility functioning during a disruption or failure of the sewage system is nearly impossible. If the blockage cannot be corrected, and alternative drainage for sewage cannot be established, evacuation of the facility must be considered. The establishment of ground-draining toilet facilities or mobile toilet units outside of the healthcare facilities, as well as mobile tank toilets, have been used successfully in past events, such as during the Algerian earthquake in 2003.

BOMB THREATS

In public buildings, a bomb threat normally is managed through an evacuation of the total building. However, in a healthcare facility, an evacuation can cause loss of lives and/or injuries, even without an explosion. Nonetheless, a bomb threat cannot be ignored. In an analysis of 275 hospital evacuations in the United States, 22 were due to a bomb threat, three were due to the placement of dummy bombs, and only one was due to the presence of an actual bomb.² It is essential that healthcare facilities use safe and accountable methods to manage a bomb threat without causing additional harm to patients.

Any member of the staff in any department of the facility may receive a bomb threat. Most often, these threats are received telephonically, but they also can be received by e-mail, or even by post. It is essential that the receiver obtain maximum information from the informer to enable optimum judgment of the risk. Any bomb threat, or the presence of a suspicious object, must be reported immediately within the facility and, then, to the appropriate external authority. Each facility must identify a central contact to which all emergencies within the institution are reported. This Central Reporting Contact within the institution must inform the authorities, and then, activate their internal plan.

It is physically impossible for the security services/police effectively to search the entire facility within a realistic time frame; and personnel from external services are not familiar with the layout or the activities within the various areas of the facility. Therefore, it is essential that staff, especially the

nursing staff, within the boundaries of safety, search the unit in which they are working for any object that does not fit the place it is in, or that appears suspicious. It must be emphasized that an explosive device can be camouflaged in any form. Examples include an explosive device camouflaged as a loaf of bread, booby traps located within incubators, and commercial explosives and even military limpet mines attached to oxygen tubing. Under no circumstances should any suspicious objects be touched or moved by members of the staff or the public. Any suspicious object must be reported immediately to the Central Control Contact from which experts are activated to investigate the object.

Bombs located in vehicles parked close to the facility or in basement parking areas can cause massive damage to any healthcare facility. If at all possible, parking lots should be secured, and all owners of vehicles in high-risk areas must be required to provide identification.

If, after a comprehensive search, nothing suspicious or threatening is found, and with the agreement of the police, an “all clear” message must be distributed to the total facility.

If, however, a suspicious object is identified, it must be reported immediately to the Central Control Contact for inspection by the security authorities, such as the police. Patients and staff must be evacuated immediately from the area surrounding the object without causing panic. Discretion, as well as expert advice from police, should be used. Hospital staff must refrain from making any unilateral decisions in this crisis situation, and must adhere to the recommendations from the police. As a rule of thumb, patients and staff are evacuated to a location in which there are at least two solid walls between the threatening object and patients/staff. Patients and staff located on floor levels that are directly above and below the area of concern also must be evacuated. In the case of a nearby suspicious vehicle, the entire building may have to be evacuated. However, it must be taken into account that evacuation of a total facility takes several hours, at best; the command to evacuate a total facility must be based on accurate, reliable, technical advice and issued by an authorized person. Depending on the country’s legislation, this command may be given by a police officer or an explosive expert from the armed forces.¹

EVACUATION

Evacuation of a hospital may occur in response to an emergency situation; as a precaution; or as a scheduled event. *Emergency evacuation* refers to an evacuation of a facility that is no longer able to provide a safe environment for its inhabitants due to a sudden-impact event or appreciated hazard, and may occur without prior warning. *Preventative or precautionary evacuation* refers to situations in which a risk or a progressive event has been determined to hold

a danger for the occupants of the institution, such as an earthquake in which the hospital still may be intact, but there are concerns regarding its integrity. A *scheduled evacuation* can occur due to events such as scheduled maintenance or repair work that will disrupt the ability of the facility, or a portion of the facility, to provide for its patients.

Evacuation emphasizes the need for prior coordination and joint planning among different healthcare institutions within the region, as other area institutions must provide support by accepting patients from the evacuating facility. This coordination must be established prior to an emergency to provide for an efficient evacuation.¹

Causes for Evacuation

Various events may necessitate the full or partial evacuation of a healthcare facility, including fire, a nature-related event, a human-related event, and the disruption of essential supply systems.

Fire

Fire is the primary cause of most hospital evacuations; the need for evacuation may be due to an internal fire or an external fire that threatens the facility. The oxygen-enriched environment of the hospital, particularly in the operating theatre where laser/cautery units are used, places the facility at increased risk for fire. Twenty-three percent of analyzed US hospital evacuations were caused by internal fire and >50% occurred secondary to hazards within the hospital, as opposed to external events.² The major causes of hospital fires are electrical malfunctions, torch incidents (cautery, welding or cutting torches), and arson.

Nature-related Events

Various natural hazards may result in an event and the need for the evacuation of a healthcare facility, either as a precaution due to the approaching hazard, or as a result of the impact of the event. Hurricanes rank as the third most common cause of hospital evacuations.² There are no accurate systems to predict the impact of an event, such as a hurricane, on an area or a specific building. In some incidents, evacuation of the facility may be a precautionary measure following a warning of an impending event. For example, a healthcare facility located in a low-lying coastal area or in a flood plain may elect to evacuate patients and staff before the full impact of a storm reaches them. A controlled, precautionary evacuation can be conducted in an orderly manner and without unnecessary risk to patients, while an emergency evacuation after an impact is conducted in a life-threatening situation and poses a substantial risk to

patients. Transporting large numbers of patients with lights and the use of elevators clearly represents the safest approach.

The structural damage to the building(s) of a healthcare facility, or the disruption to the infrastructure of the building (such as sanitation) also may necessitate evacuation of the facility. Examples of this include the impact of Hurricane Katrina in 2005,¹¹ in which flooding made the area uninhabitable and required the evacuation of the healthcare facilities in New Orleans; the damage to the hospital's infrastructure in Darwin, Australia, in 1974 after Cyclone Tracy struck the city, necessitated the evacuation of the entire city, including the hospital; and the structural damage to hospitals in Algeria during the earthquake in 2003, which rendered the buildings unsafe and required the evacuation and closing of affected hospitals. In 1971, the Veterans Administration Hospital in Sylmar, California in the United States partially collapsed during the San Fernando earthquake, causing 49 fatalities.² Ground movement after an earthquake also can disrupt sewage systems, resulting in a total failure of sewage drainage and water supplies, which may necessitate the evacuation of a healthcare facility.

Chemical Spills and Hazardous Material (HazMat) Situations

Various chemicals and hazardous materials are used within hospitals or nearby research facilities, or are transported to areas near hospitals. A spillage of a hazardous chemical or substance in or just outside a hospital may require the partial or even total evacuation of the healthcare facility. Incidents involving hazardous chemical materials constitute the second most common cause of hospital evacuations.²

Biological Contamination

Accidental, purposeful, or nosocomial contamination of a hospital by a biological agent also may necessitate the evacuation of part of a facility until proper decontamination measures can be executed. Theoretically, it is possible that the entire facility may become contaminated with a virulent organism that necessitates the evacuation of the total facility. This may involve the contamination of the air conditioning system with an air-transmittable organism, resulting in the contamination, and thus, inhabitability of a facility. In 1986, the City of Hope Medical Centre in Duarte, California, United States evacuated two wards of its hospital because of an outbreak of Legionnaire's Disease that caused the deaths of three patients.² The hospital's cooling system was the primary suspect in the organism's transmission.

Essential Supplies Disruption

As discussed, a healthcare facility relies on a variety of supplies to function

optimally. This includes medical supplies, human resources, and utility supplies, such as water and electricity. When one or more of these supplies are disrupted or discontinued, it influences the functioning of the facility. When a major supply is disrupted, it may jeopardize functionality to the extent that the facility cannot continue functioning and must be evacuated.

Evacuation Process

The formal decision to order the total evacuation of a healthcare facility is restricted to the top executive of the institution, in consultation with expert advisors from the emergency services, often the Fire Brigade. It is advisable that the top executive makes the decision, time permitting, in consultation with his/her planning group and, then, shares the decision with the governmental authorities responsible for the affected area.¹ Although the decision to evacuate the total complex (especially an acute care facility) must be made only by the top executive or the authorized authority, such as the fire brigade officer in charge, any healthcare professional should assume responsibility for an immediate, partial evacuation from a specific area when, and if, needed for the patients' safety, without any need for a higher authorization.

In the event that evacuation may not be possible due to blocked exit routes or is considered to be too risky, the decision to shelter in place may be necessary. In a battle zone, this command often is given in the event of an attack, especially an air-attack, in which it is not possible to get patients out before the attack occurs.

As part of the planning and training for an evacuation, all escape routes must be identified and clearly marked, and remain visible even during power outages. Within each department or section, it is the responsibility of the senior staff member on duty to inform staff and, if applicable, patients to evacuate using clear, calm, verbal commands. A guide to evacuation route decisions is to create a logical, safe sequence for the use of the emergency exits, fire escapes, or fire lifts (if available), to prevent a hazardous stampede.

Types of Evacuation

With modern fire prevention measures and structural engineering designs of healthcare facilities, it seldom is necessary to evacuate an entire facility because of fire. However, other hazards may necessitate the complete evacuation of a facility, as occurred in nearly a dozen hospitals in New Orleans following Hurricane Katrina.¹² It is essential that the risks of the threat(s) and of the evacuation are analyzed and clear guidelines are given for the evacuation, including whether it will be a partial, complete, horizontal, or vertical evacuation.

As soon as a risk, usually a fire, is discovered, an alarm must be raised. Thereafter, staff must focus all of their efforts on moving patients to safety.

Horizontal Evacuation

To the extent possible, patients first should be moved horizontally to a safe location on the same level or floor, but on the opposite side of the building. This is much faster than moving patients between levels of a building (vertical evacuation) and allows patients to be moved to an area of relative safety within a fairly short period of time. In single-story buildings, patients may be moved directly out of the building during horizontal evacuation.¹³ Depending on the situation, horizontal evacuations may be followed by later vertical evacuations.

Vertical Evacuation

When horizontal locations are not safe or are no longer considered safe due to an evolving event, patients in multiple-story facilities must be moved vertically to safety. If the incident is localized, patients can be moved to other floors, typically at least two floors beneath the incident floor. As a principle of evacuation, vertical evacuation is always performed downwards, to get all patients as low as possible toward the building exits. In extreme conditions, where all exits to lower levels are blocked, patients can be evacuated upwards to higher levels, even to roof-top locations. This was the condition in several hospitals in New Orleans following Hurricane Katrina; flooding eliminated the use of lower-level exits.

Emergency Actions

During a fire event, the first emergency action is for patients to be removed from their beds immediately and made to lie down on the floor to move them away from any developing smoke. Blankets can be used to drag patients to safety if there is imminent danger in their current location. It is not recommended that hospital mattresses be used for this purpose, as mattresses normally are covered with a slip-resistant covering making it very difficult to drag over hospital floors polished with a slip-retardant floor polish. It is essential to emphasize that rescuing patients from a healthcare facility is an extremely dangerous and specialized activity, and is best performed by professional, trained rescue personnel with the necessary protective gear. When and if this service is available, healthcare professionals should leave these activities to these experts. However, this never is the case in emergency evacuations.

In all evacuations, particularly those resulting from planned disruptions in services, staff should plan the evacuation by evaluating the needs of existing patients. This involves:

1. Performing a rapid triage to determine the needs of patients during the evacuation; this should be done by the charge nurse/nursing supervisor and/or medical personnel present in the department or unit;

2. Determining which patients will be able to evacuate themselves without help, who will be able to evacuate with little assistance, who will require wheelchairs or stair-chairs to be moved, and who must be evacuated lying down;
3. Determining which patients face a greater risk from evacuation than from remaining inside the facility; and
4. Using rapid triage information to provide critical planning data for the staff to ensure rapid implementation.

In general, patients are evacuated in the following order of priority:

1. Patients in immediate danger;
2. Ambulatory patients;
3. Patients in bassinets, cribs, wheelchairs; and, lastly,
4. Bed-ridden patients.

The evacuation of acute care patients requires rapid patient preparation, including: removing them from oxygen and switching mechanically ventilated patients to room air or to a portable oxygen tank; disconnecting intravenous lines from infusion pumps; disconnecting intravascular catheter lines from transducers and pressure bags; and switching electrocardiogram (ECG) connectors from the bedside monitor to a portable monitor, if available. During the evacuation process, ventilated patients must be bagged using a bag-valve-mask. Patients receiving dialysis must have the process discontinued immediately in preparation for evacuation. Patients on a balloon pump should have the device switched to battery operation and be evacuated with the device functioning. Acute care patients should never be left unattended.

Patients who are in the operating theatre at the time of a formal evacuation should be attended to by the surgeon, anesthesiologist, and operating theatre nurse. If anesthesia has been started, but the surgical procedure has not yet started, the anesthesiologist should terminate the anesthesia as soon as safely possible, and the patient should be evacuated to a safe location accompanied by the anesthesiologist. If the surgical procedure is underway, the surgeon should determine the safest course of action for the patient.

The size of newborns and infants allows them to be evacuated readily by placing two infants in one bassinet, and then either placing several bassinets onto a gurney or manually carrying two bassinets



Figure 9.1: Evacuation of newborns with placement of two babies plus supplies in each basinet which are placed on a gurney for transportation

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Photo courtesy of Theo Ligthelm

Figure 9.2: A hospital staff member evacuating three babies using an evacuation apron



Photo courtesy of Theo Ligthelm

Figure 9.3: Ambulatory children and young adult patients, holding hands, are led and followed by a staff member to an exit during a hospital evacuation because of fire. All patients are covered with wool blankets to protect them against possible flames during the evacuation.

at a time to a safe location (Figure 9.1). Alternatively, special evacuation aprons may be used to evacuate several infants at a time (Figure 9.2). The preparation of critically ill neonates is as described for the acute care patients.

Once patients have been prioritized and prepared for evacuation, they must be moved to an area where accesses to the fire escapes or stairs are unobstructed and, in the case of a fire, there is at least one solid wall with smoke doors separating them from the fire. It is very difficult to maintain oxygen supply to a patient during an emergency evacuation; cylinders are heavy and cumbersome to move down fire escapes. Where patients need to be moved through a burning area, cylinders of oxygen also pose a serious risk and are absolutely not recommended. Private possessions of patients seldom can be accommodated during an emergency evacuation, and patients must not be allowed to waste time packing their personal belongings in an emergency evacuation. If safety permits, it is essential that the person in charge of the area move through their area of responsibility as a final action to check that all staff and patients have been removed from the area.

Evacuating ambulatory patients before those who are bed-ridden prevents situations such as prolonged obstruction of a stairwell during attempts to move a critically ill patient with equipment down the stairs, perhaps preventing hundreds of ambulatory patients from evacuating during that time. Although policies may differ in a non-emergency evacuation, the disaster triage principle of doing the greatest good for the greatest number of people supports the practice of sending mobile, self-moving patients down the stairs first, before efforts

are made to move non-ambulatory patients. Mobile patients should be assembled, hold hands, and be led by a staff member with another staff member following them down the stairs (Figure 9.3).

Moving non-ambulatory patients down stairs is very labor-intensive and time-consuming. All available manpower must be mobilized to assist in transferring these patients down stairs and out of the building. For planning purposes, four to six people per non-ambulatory patient are needed to evacuate down stairs. All staff of the institution (including maintenance, housekeeping, laundry, security, administrative, and clinical staff) must be mobilized to assist in this transport process. Often, large healthcare facilities have agreements with external sources for additional manpower, such as staff from a local military base, to assist in carrying patients out of a building.

Various research projects have been undertaken to estimate the time required to carry patients out of a multi-story building. Gildea and Etengoff¹⁴ estimate that 3.75 minutes/floor/patient are required for evacuation and have developed the following formula to calculate the time required:

$$T_e = 3.75 \times F \times P/T$$

Where: T_e = evacuation time (minutes);

3.75 = evacuation time (minutes) for one patient/one floor;

F = the number of floors;

P = the number of patients; and

T = a four-person carrying team.

Various carrying methods can be used, such as the two-person carry, in which a seat is formed by two helpers grasping each other's hands and having the patient sit on their hands; this method is especially useful to carry frail, elderly patients down stairs. Many institutions have special lifting devices mounted inside the emergency stairs for use in evacuation. These may include commercial basket stretchers, which are basket-type, full-body size stretchers made of fiberglass or mesh-wire in which the patient is secured and, then, carried down the stairs. Other transport devices such as Stryker®, Evacusled®, Supersled®, and MedSleds are available commercially and may minimize the number of persons required to assist with the move. Another advantage of some of these types of devices is that they can be lowered by rope out of windows, or hoisted up by crane or helicopter. However, when using such devices, it is essential that a clear rotation system is planned so that they are returned to the various floors through a separate route to be used for the next patient; institutions seldom stockpile enough for all non-ambulatory patients. It is recommended that two to five of these devices be mounted against the walls inside the emergency stairs of each floor or ward.

Alternative methods of transporting patients during an evacuation include the use of spine boards, which are constructed of marine plywood or a similar strong wood; patients are secured with straps through holes in the side of the board. These boards are less expensive to stockpile and take up less storage space than basket stretchers. Canvas-type, collapsible, NATO-design stretchers also can be used. For patients who are not ambulatory, but who can sit, a glider chair or a Stryker® chair that can be managed on stairs by a single individual is useful.

A drag sheet can be used to move patients horizontally and, in certain facilities (especially facilities with large numbers of frail and helpless patients), a drag sheet is placed under all mattresses in the facility. The use of these drag sheets dramatically decreases the time required to evacuate non-ambulatory patients from a facility.¹⁵

Assembly Points

Assembly points are pre-determined locations outside of the facility where staff and patients assemble or are brought together after the evacuation for control, care, and subsequent transfer. These points must be close enough to the building for the practical movement of patients to these points, but far enough away for safety. If adjacent buildings (such as a recreation hall next to the building, the staff dining hall, or medical school facilities) are available, they can be utilized to provide shelter. A sheltered facility is ideal, but, if not available, an open area, such as a parking lot, may be utilized.

In large facilities, it may be necessary to create more than one assembly point; for example, an assembly point may be established for each fire escape. The assembly points must be large enough to accommodate the maximum number of patients from the area, the staff members, and all visitors that may be in the building at the time of the evacuation.¹⁵ A high-priority assembly point often is created for all patients from the operating theatres, ICUs, and the nursery for quick evacuation to alternative care facilities.

In the assembly point area, nursing staff must determine if any person is missing, or still is in the building. If patient name lists are available, patients should be checked against the name list. Assembled staff members also should be checked against the current duty roster. These determinations are best made by assembling patients and staff according to their unit or department of the facility. Some institutions have pre-manufactured banners, which are erected at the various assembly points; evacuees assemble at the appropriate banner or notice board (e.g., "Assembly Point Ward 12"). It is essential that all evacuees be taken to the assembly point before being transferred to other facilities.

Patient care at the assembly points usually is limited to life-saving interventions and to providing basic comfort.

Transferring Patients

After the evacuation from a facility, patients must be discharged or transferred to other facilities of care. This may be to other hospitals, to temporary accommodations, or even to private homes, depending on the situation and the needs identified. The number and type of receiving facilities required is determined by the size of the facility and the acuity of the patients that are evacuated. If a 900-bed, Level 1, academic hospital is evacuated, nearly all hospitals in the region will need to be activated to receive its patients, whereas the evacuation of a 30-bed, private nursing home often can be readily absorbed by one large, city hospital. Critically ill patients with specialized care needs, such as neonates or burn patients, need to be transferred to hospitals capable of providing specialty care. In some instances, this may require that specialized nursing staff not only accompany the patient during transfer, but also remain on duty at the receiving hospital to provide needed care to the transferred patient. This occurred in Texas, the United States, following storm Allison, which necessitated the evacuation of a large, urban teaching hospital. While some receiving hospitals had available beds, they lacked the nursing staff and equipment to care for the transferred critically ill patients; nursing staff and equipment were sent along with the transferred neonatal patients, and remained to provide care in the receiving facility.⁸

It is essential that all potential receiving hospitals be notified immediately of the evacuation in order to activate their own external disaster plans. If possible, faxing pertinent patient information to the receiving facility is helpful. However, it must be considered that other healthcare facilities in the region may be facing similar conditions and that receiving facilities may have to be sought in other regions, or other states, and may be non-traditional

	PATIENT'S NAME	MEDICAL RECORD NO.	AGE OR DOB	PRIMARY DIAGNOSIS	TRANSFERRING FACILITY	TRANSFERRING PHYSICIAN	RECEIVING FACILITY	MODE OF TRANSPORT	DEPARTURE DATE AND TIME	EQUIPMENT SENT	MEDICATIONS SENT	MEDICAL RECORD SENT (YES/NO)	PERSONAL BELONGINGS/ VALUABLES
1													
2													
3													
4													
5													
6													
7													
8													

Figure 9.4: Sample patient transfer tracking sheet (Modified from Distefano *et al*¹⁹)

facilities, such as the Houston Astrodome (a sports stadium) or even a veterinary hospital. This underscores the need for disaster planning that extends beyond the institution and involves widespread potential participants.

It is recommended that the available and suitable hospitals that are closest to the evacuated facility be used for critical patients from the operating theatre or intensive care units. This allows these facilities to provide optimal care to these high-risk patients while minimizing the challenges associated with long-distance transportation. It also is recommended that nearby hospital(s) be designated as stabilization facilities, to resuscitate and stabilize patients before transferring them on to a receiving hospital further away for ongoing care.

If no receiving facilities are available within realistic distances, it may be necessary to establish temporary facilities in the direct vicinity of the affected hospital, until a long-distance transport plan can be implemented. Temporary facilities can be established in schools, warehouses, or similar types of buildings. In some instances, it may be useful to deploy temporary military field hospitals to the community to substitute for the destroyed facility, and to provide care for the community (and possibly the evacuated patients) until the facility is repaired or a more permanent solution is implemented. However, deploying military field hospitals, especially large facilities with surgical capacity, is a time-consuming process taking at least 48 hours to become functional.

Paper record-keeping is essential to create a database of all transferred patients; this can also incorporate the use of patient identification bands. A roster listing each patient, the facility to which they are sent, and the time and mode of transportation must be maintained at each assembly point. Accompanying equipment and staff data should be included. Figure 9.4 illustrates a sample log to be used during an evacuation. To ensure continuity of care, it is vital that the patient's medical record accompany him/her to the receiving facility.

HOSPITAL EMERGENCY EVACUATION

In 2004, an earthquake in Northern California led to the evacuation of eight acute care hospitals. Six of the hospitals evacuated their patients within 24 hours of the event because of water damage and power outages. The staff at one of these six hospitals felt that the patients were in immediate danger and emergently evacuated all ambulatory patients, followed by evacuation of all non-ambulatory patients. Within two hours, the hospital staff had evacuated a total of 334 patients. With flashlights providing the only available light, the staff utilized wheelchairs and mattresses to evacuate the patients. Ventilator-dependent patients had to be manually ventilated for two hours until portable generators could be obtained and set up in patient-safe areas (i.e., on the lawn across from the hospital).⁵

Robert Powers

Transportation

Loading points must be established adjacent to assembly points, where available transport is loaded with outgoing patients and directed to the designated receiving institution. Evacuation routes must be determined in advance, and local traffic authorities must ensure that the routes are open and accessible for emergency vehicles. Emergency services will establish *staging areas* close to the facility where transport vehicles are assembled, ordered, and, then, dispatched to the loading point, as required.

Various modes, and often all available modes, of transport are used to move large numbers of patients from an impacted facility to other facilities. It is essential that facilities enter into memoranda of agreement with service providers in advance so as to secure the provision of transportation when needed for an evacuation. The same type of agreement can be used for buses, aircraft, and other modes of transportation.¹⁶

Transportation options include those discussed below:

Ambulances

Various levels of ambulance service provide the quickest and most suitable means to transport patients to receiving facilities. Depending on accompanying equipment, most ambulances can transport one–two non-critical patients, or several pediatric patients, at one time. The establishment of an effective circular route is necessary to transport patients from the loading points, drop them off at the receiving facilities, and return to the loading point.

Buses

The use of public and private buses to transport mobile patients can ease the load on ambulance services and can provide the rapid transport of large numbers of ambulatory patients. However, ambulance ports at receiving hospitals often cannot accommodate buses, requiring the establishment of an alternate unloading point at the receiving hospital. Accommodating arrangements with the receiving hospitals must be made in advance.

Aircraft

Air transport often is an option for the long-distance transport of patients to specialized care facilities. Large, military, transport planes provide the ability to transport large numbers of patients in a relatively short period of time. However, these aircraft seldom are equipped for acute care; their use may require an initial transfer of patients to a nearby hospital for stabilization before being transported by air to a facility in another area. Additionally, military aircraft require commercial landing strips, which usually are available only in major cities. Helicopters also can be used in the evacuation process to



Figure 9.5: A boat being used to transport an evacuated, intubated, neonate to a waiting fire truck for transfer to a receiving hospital in New Orleans following Hurricane Katrina

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transport patients. Limited space within the aircraft and appropriate landing space may be limiting factors with helicopter use. However a large, military helicopter transported 29 infants plus several of their mothers from a New Orleans hospital following Hurricane Katrina.¹⁷ Military transport aircraft (i.e., C-160) can transport up to 72 stretcher patients in a mass evacuation.

Railway

Rail transport must not be overlooked as an option for moving large numbers of patients over a relatively long distance. When hospitals evacuate as a precaution due to an approaching weather event, rail is a very useful commodity for moving patients who do not require electrically-powered equipment. Using standard overnight sleeper cars, patients can be positioned on railway beds and needed nursing care can be provided by a group of nurses assigned to each coach. Using light freight carriages, such as parcel carriages, acute care can be provided during rail evacuation.

Boat and Ship

The use of ship transport obviously is applicable only from cities linked to waterways or the sea. Because of the time constraints, it seldom is practical to bring a military hospital ship into harbor to receive emergently evacuated patients. Additionally, there are very few hospital or rigged, casualty-receiving ships available worldwide. However, the uses of boats, both private and commercial, have been used successfully in several evacuations due to flooding (Figure 9.5).¹⁸

IN JUNE 2001, tropical storm Allison caused extensive flooding and power outages in the 450-bed adult and 150-bed children's hospitals affiliated with the University of Texas, Houston Medical School in Texas. Most roads to the hospitals became impassable. Initially, only patients receiving ventilatory assistance were evacuated; thereafter, all patients were evacuated. Triage officers supervised the evacuation of adult and pediatric patients from the ICUs. The availability of beds in one hospital that lacked staff and equipment resulted in the transfer of the patients of one entire ICU to that hospital along with accompanying nursing staff and ventilators. To ensure continuity of care, physicians were given emergency privileges at the receiving hospitals. Over a period of 31 hours, 169 patients were discharged from the hospital, and 406 patients were transferred by ground or air ambulance to 29 hospitals throughout Texas.

Reported lessons learned from this experience include:⁸

- Flooding will occur in facilities in a flood plain — plan on it;
- Electrical power outages should not be considered to be temporary; if prompt restoration cannot be assured, begin evacuation;
- Appoint a Triage Officer from the available staff to coordinate the evacuation; this person should be knowledgeable about the hospital and patient care;
- Establish a Central Command Centre for communication between the Triage Officer and persons communicating with receiving hospitals;
- Ensure a reliable in-house communications system independent from telephone lines and electricity; have fully-charged, two-way radios and cellular telephones available in all units;
- Have a reliable communications system for contacting outside facilities;
- Have flashlights with fresh batteries available on all units (one/caregiver and one/each patient or patient room);
- Have battery-operated exit signs and stairwell lights throughout the hospital;
- Maximize the use of volunteers when they are available and fresh at the beginning of their shift;
- Maintain a paper record of all patients, their attending physician, the receiving facility, and the receiving physician, if available;
- Ensure all patient transfers and discharges are coordinated by the person in charge;
- Coordinate the loading of patients into ambulances and helicopters to maximize transport capability while considering patient safety; although helicopters may have the capacity to carry two or three patients, critically ill patients with equipment and staff may have to be transported singly; likewise ambulances may be able to transport two adults and several children and infants at one time;
- If possible, try to avoid having many patients arrive at one facility at once;
- Create a hotline for the purpose of reassigning staff to care for patients during transfer and/or at the receiving facilities;
- Ensure back-up of fresh batteries for ventilators, remembering that the life of these battery packs is approximately two hours;
- Place keys to electrically-operated medication systems in an accessible location (such as on the crash cart on each unit) to ensure medication access;
- Institute an equipment tracking system to recover equipment sent to other facilities with a patient; and
- Locate all electrical panels away from potential flood areas; only services not critical to patient care should be located in the lower levels of the hospital.

Elaine Daily

Resumption of Hospital Activity

Irrespective of the cause of the internal disaster, the routine functioning of the institution becomes disrupted. It is the responsibility of the hospital executive staff to liaise with the authorities and experts regarding the determination of when the building can be re-occupied and functions restored. This determination must be based on confirmation that the building is safe and habitable, and that support services are available.

CONCLUSION

Internal disasters may occur in healthcare facilities as a result of a myriad of events that impact their ability to function and potentially cause an unsafe environment, or one in which patients cannot receive the necessary level of care. It is essential that healthcare professionals are trained to implement emergency measures effectively and immediately during these events in order to protect the lives both of patients and of fellow staff members.

Although it is not possible to plan for every eventuality, healthcare facilities must perform a thorough analysis to identify the most likely incidents that they may encounter and for which they must be prepared. These identified internal risks should drive the development of plans, which are then tested regularly with the full participation of as many of the facility's staff as possible, and become incorporated into the daily operations of the institution.

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CHAPTER 10

HEALTHCARE FACILITIES INCIDENT COMMAND

Craig DeAtley

PREPAREDNESS AND ORGANIZATION of a healthcare facility are required to maximize the utilization of the available resources to provide the highest achievable level of care for the community during a disaster. This requires the development of an Emergency Management Program (EMP) aimed at: (1) protecting the facility and its people (patients and staff); (2) responding to the community's increased healthcare needs; (3) continuing to provide healthcare services; and (4) assuring the safety of all involved. In contrast to a hospital's usual way of functioning and managing healthcare utilizing consensus decision-making based on extensive data, responding to a large-scale crisis requires that time-sensitive decisions be made with imperfect information. Controlling the situation not only requires planning, it requires the delineation of alternate roles and responsibilities of hospital staff in an organized management system. Central to this organization is a command structure that details the roles and responsibilities of those involved in leading the healthcare facility through all phases of a disaster. In the United States, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires that hospitals establish a hospital Incident Command System (ICS).¹ Beginning in 2006, the US Department of Health and Human Services outlined in its Hospital Preparedness Program similar expectations in an effort to promote hospital compliance with National Incident Management System (NIMS) principles, including the use of an ICS that is consistent with that found within the facility's community.²

OBJECTIVES:

- Describe incident command and the advantages of using an ICS.
- Explain the four ICS management functions; and
- Understand the position and components of the hospital ICS.

Incident management focuses on command, control, and coordination through a responsibility-oriented chain of command. Roles and responsibilities are clearly defined and rehearsed in drills to ensure understanding of the scope of the assignment and the chain of command. These roles should be created from the hospital's Emergency Operations Plan (EOP), which details who is in charge as well as the implementation strategy for the appropriate Incident Command System.

The organizational emergency preparedness efforts that a healthcare facility undertakes also should address the requirements from government agencies such as the US NIMS, and pertinent non-governmental organizations, e.g., the JCAHO.¹⁻³

THE INCIDENT COMMAND SYSTEM

The *Incident Command System* (ICS) is an "all-hazard" approach to incident management that is driven by responsibility/position rather than by person. Importantly, ICS is a flexible organizational structure capable of shrinking and expanding based on the size and complexity of the event.²⁻³ The foundation for the current ICS was developed in the 1970s by an interagency task force of local, state, and federal personnel. Initially, the system was designed to coordinate fire personnel combating large-scale responses, and was developed to correct the myriad of response-related problems that repeatedly were found by the task force analyses of prior major incidents. These problems included:

- Inadequate communication because of conflicting terminology or inefficient or improper use of technology;
- Lack of a standardized management structure that would allow integration, command and control, and workload efficiency;
- Lack of personnel accountability; and
- Lack of a systematic planning process.

The persistent occurrence of these problems resulted in unnecessary risk to responders, excessive damages, and avoidable fiscal losses. In an effort to minimize the occurrence of these problems, the ICS design is meant to:

- Manage all routine, planned events or emergencies, of any size or type, by establishing a clear chain of command;
- Allow personnel from different agencies or departments to be integrated into a common structure to effectively address issues and delegate responsibilities;
- Provide needed logistical and administrative support to operational personnel; and
- Ensure key command functions are assigned, and eliminate duplication.

The Incident Command System (ICS) is based on the premise that every untoward incident or event requires that certain management functions always be performed and managed by trained and experienced personnel. Individuals in charge evaluate the problems encountered and write an Incident Action Plan (IAP) for each operational period, i.e., the time required to accomplish a set of objectives. The IAP outlines the overarching control and strategic operational objectives established to remedy the identified problems, and determines how needed resources will be managed.

The ICS design differs from that used in the daily administrative structure of the agency or healthcare facility. If the usual administrative structure and response practices allow adequate management of the problem, then an emergency response is not warranted, and an ICS is not required to be activated.

ICS Positions

The ICS utilizes standard, functional positions within its organizational structure; however, not all positions are required for every response. Only those positions that have functions necessary in the current situation are activated; there must be a designated person in charge of each function that becomes operational. The use of the standardized position titles in the ICS structure serves three essential purposes; it:

- Reduces confusion within a hospital, or with outside agencies, or other healthcare facilities, by providing a common name for all users;
- Allows the position to be filled with the most qualified individual rather than by seniority; and
- Facilitates requests for qualified personnel, especially personnel from outside of the hospital.

The *Incident Commander* is the person in charge of the mission, and is the only position that always is activated for an incident, regardless of its nature. The Incident Commander defines the mission, sets all response objectives, devises strategies and priorities, maintains overall responsibility for managing the incident, and ensures its completion.

The Incident Commander may choose to activate the following Command Staff positions:

- A *Public Information Officer* to coordinate information sharing with internal personnel and the media;
- A *Safety Officer* to monitor operations from a safety perspective and assure the safety of all assigned personnel; and
- A *Liaison Officer* to serve as the primary contact for external agencies working with the hospital and to coordinate assistance requests to the Local Emergency Operations Center (LEOC).

In select situations, the Liaison Officer may be assigned to represent the hospital at the LEOC or at the field Incident Command Post.

In addition to the Commander and the Command Staff, there are four Sections that comprise specific management functions within an ICS; each is under the direction of an assigned chief who reports to the Incident Commander. These positions consist of the:

- *Operations Section Chief*, who is responsible for directing all tactical operations (e.g., patient care and facility operations) required to carry out the IAP by using the defined response objectives and by directing all needed resources;
- *Planning Section Chief*, who is responsible for collecting and evaluating information for decision support, maintaining resource status information, preparing documents, such as the IAP, and maintaining documentation for incident reports;
- *Logistics Section Chief*, who is responsible for providing support, resources, and other services essential to meeting the response objectives set by the Incident Commander; and
- *Finance/Administration Section Chief*, who is responsible for monitoring all costs related to the incident while providing accounting, procurement, time recording, and cost analyses to maximize financial recovery and reduce liability.

Each of these four primary management sections may be subdivided to meet the management demands of the incident. Small-scale incidents require fewer personnel to serve Incident Command roles than do large-scale events. The type of incident and the availability of trained personnel resources dictate the composition of the Incident Management Team.

ICS Components

In addition to the Incident Commander, his/her four assistant Command Staff, and the four major functional sections, the ICS may be further divided into organizational components with a distinct title given to those in charge. These include:

- *Divisions* — used to divide an incident or facility geographically (e.g., first floor). This command function typically is used among non-hospital response agencies, such as fire and law enforcement authorities. Each Division is led by a Supervisor;
- *Groups* — established to divide the incident management structure into functional areas of operation. They are composed of resources that have been assembled to perform a special function not necessarily within a single geographical division.

- Each Group is led by a Supervisor;
- *Branches* — created when the number of Divisions or Groups exceeds the recommended span of control (e.g., Medical Care Branch and Service Branch). Each Branch is led by a Director;
- *Units* — organizational elements that have functional responsibility for a specific Planning, Operations, Logistics, or Finance/Administration activity (e.g., Inpatient Unit, Situation Unit and Supply Unit). Each Unit is led by a Unit Leader; and
- *Single resources* — individual(s) or a piece of equipment with its personnel complement (e.g., perfusionist) or a crew or team of individuals with an identified Supervisor.

The government, the police department, and the fire department may use two other organizational levels not routinely used in the hospital setting: a Task Force and a Strike Team. A *Task Force* is a combination of mixed resources (e.g., an ICU staff of nurses, technicians, and station/unit secretaries) with a common communication capability that is led by a Task Force Leader. A *Strike Team* is a set number of similar resources (e.g., burn nurses) with a common communication capability who operate under the command of a Strike Team Leader. Either a Strike Team or Task Force may be sent to assist a healthcare facility that requests personnel with specific expertise during an emergency.

A deputy position may be appointed to assist the Incident Commander, the Section Chiefs, and the Branch Directors either to allow for their absence or to provide other delegated assistance. An assistant also may be assigned as a subordinate to a command position; this position has no supervisory authority, but performs important technical tasks and has administrative support responsibilities. He/she also may be assigned to assist a unit leader as situational needs dictate and resources allow.

Individuals in charge can delegate authority to others when necessary, through a chain of command. This allows an effective span of control to be maintained to ensure safety and accountability. The recommended practice for the delegation of authority is to limit personnel management to a ratio of one supervisor to three-to-seven (1:3–7) reporting elements.^{1–4}

Unified Command

Within a healthcare facility, the Incident Commander position is fulfilled by a single individual. However, emergency management at the scene of the incident (e.g., a fire or major accident) may involve other authorities, including state and federal representatives, who work together under a *Unified Command* structure. In this situation, Incident Commanders from the various responding agencies, hospitals receiving patients, and other jurisdictional rep-

representatives (i.e., public health, emergency management) share the responsibility for on-site management of the incident. In Unified Command, the core group of representatives collectively manages the response from one Incident Command Post, using a consolidated IAP to guide response activities. The cooperation of all agencies involved is essential for a successful Unified Command. Each agency must support consensus decisions, and commit necessary resources to achieve the identified response objectives.

HOSPITAL INCIDENT COMMAND SYSTEM

The original Hospital Emergency Incident Command System (HEICS) was developed in the early 1980s for use by hospitals, and was modeled after the ICS known as FIREScope, which was created by US Forestry Service and fire department personnel. Since its inception, the HEICS has become an important foundation for the ICS and is used by more than 6,000 hospitals in the United States, as well as worldwide.⁴ In 2005, the California Emergency Medical Services Authority (the proprietary owner of HEICS) convened a National Work Group of 27 subject matter hospital emergency preparedness experts to craft HEICS IV (the previous edition was published in 1998). The purpose of the HEICS IV project was to build upon the work accomplished in the previous three editions of the HEICS, and to expand upon the existing fundamental elements by clarifying the components of the system and its relationship to the new US NIMS. This included integrating chemical, biological, radiological, nuclear, and explosive (CBRNE) events into the management structure, and to develop a standardized and scalable incident management system to address planning and response needs of all hospitals, including rural and small facilities. The new, comprehensive, modular design and flexibility of the HEICS IV edition is intended to be used for preplanned and non-emergency incidents, as well for emergency incidents. Hence, the “E” for emergency was dropped from the HEICS acronym, and the new system is called the Hospital Incident Command System (HICS).⁴

HICS Positions

The HICS uses the fundamental ICS principles and command positions and applies them to the healthcare facility setting. The Incident Management Team (Figure 10.1) consists of the previously described ICS command and general staff positions plus the use of Branches and Units to maintain an effective span of control. Unique to the HICS Command Staff is the position of Medical/Technical Specialist. This group of personnel with specialized expertise can serve as consultants to the Incident Commander (or any other command position at the direction of the Incident Commander), or may be given command authority if needed by the Incident Commander.

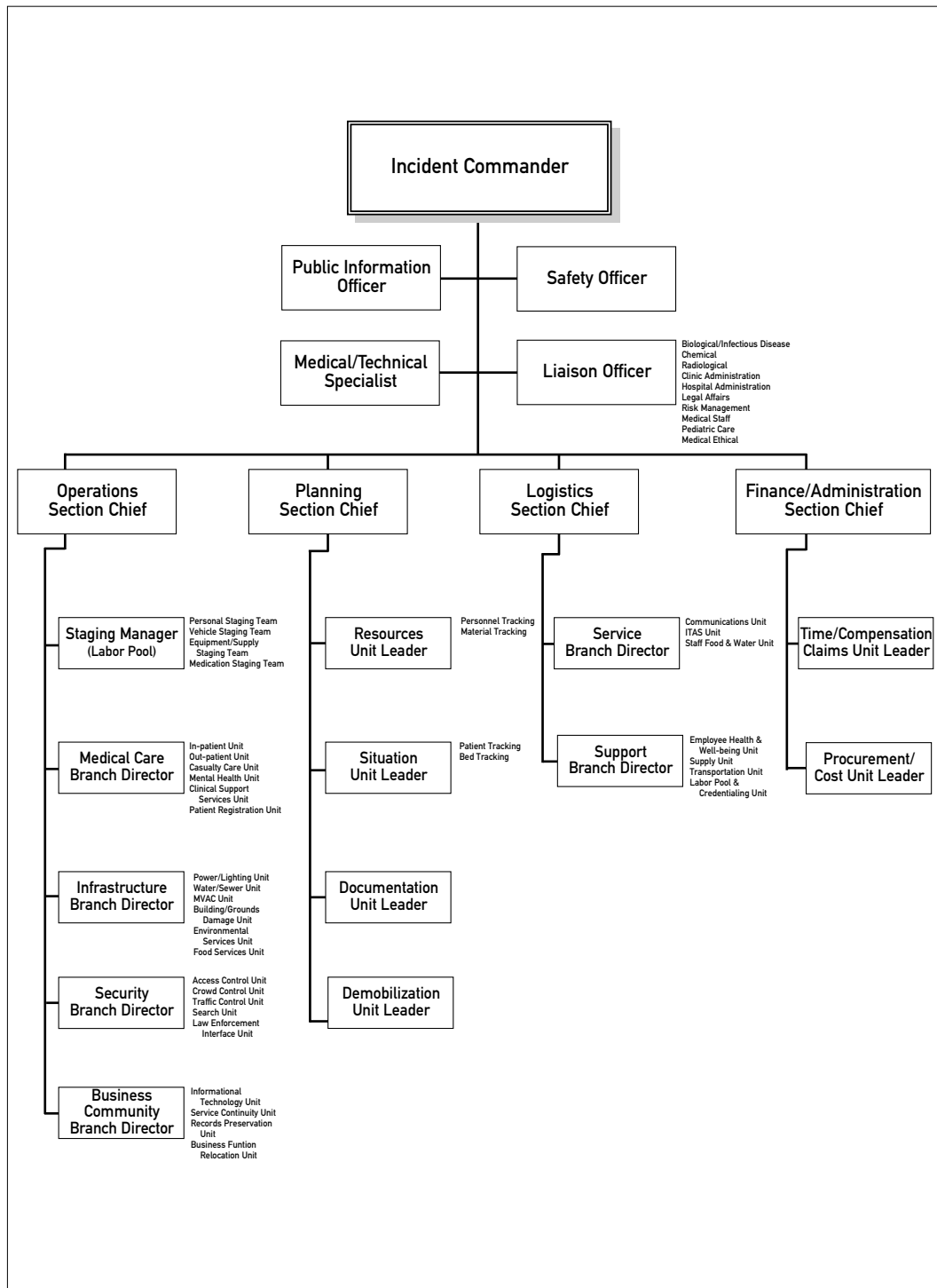


Figure 10.1: Flow chart identifying all potential functional positions within the Hospital Incident Command System (MVAC = Mechanical, Ventilation, and Air Conditioning; ITAS = Integrated Time and Attendance Systems)

The *Operations Section* usually is the largest section of the HICS due to its responsibility for performing all the tactical activities of the response. Branches may be activated by the Operations Section Chief, depending on the situation. Each Branch Director has individual Units of activity reporting to him/her.

Branches that may be activated by the Operations Section Chief include:

- A *Medical Care Branch* — responsible for all activities and areas related to patient care/service including Inpatient Unit, Outpatient Unit, Mental Health Unit, Clinical Support Service Unit, and Patient Registration Unit;
- An *Infrastructure Branch* — responsible for the Building and Grounds Damage Unit, the Power/Lighting and Water/Sewer Units, the Heating, Ventilating, and Air Conditioning (HVAC) Unit, the Environmental Services Unit, the Medical Gases Unit, the Food Services Unit, and the Medical Devices Unit;
- A *Security Branch* — responsible for the Access, Crowd and Traffic Control Units, the Search Unit, and the Law Enforcement Interface Unit;
- A *Business Continuity* — responsible for activities related to the Information Technology Unit, the Continuity of Service Unit, the Records Preservation Unit, and the Business Function Relocation Unit; and
- A *HazMat Branch* — responsible for the Detection and Monitoring and Spill Response Units, and both Victim and Facility/Equipment Decontamination Units.

A *Staging Manager* coordinates available resources awaiting a designation and also reports to the Operations Section Chief.

The *Logistics Section*, whose activities involve procuring items and services, i.e., “getting things”, can be subdivided into two branches as the situation warrants. These two branches are the:

- *Service Branch* — responsible for supporting communication via the Communications Unit, Information Technology/Information System (IT/IS) resource needs via the IT/IS Unit, and food and water for staff via the Staff Food and Water Unit; and
- *Support Branch* — responsible for coordinating resources for employee health via the Employee Health and Well-being Unit, family care via the Family Care Unit, acquiring needed supplies via the Supply Unit, supporting infrastructure operations via the Facility Unit, coordinating internal and external transportation via the Transportation Unit, and acquiring and credentialing additional personnel via the Labor Pool and Credentialing Unit.

The *Planning Section* primarily is responsible for documentation coordination including writing the draft IAP for each operational period, along with analyzing and archiving all records created by the healthcare facility's responses to the situation. Positions within the Planning Section may include the following units, each under the direction of a Leader:

1. The *Situation Unit*, which is responsible for writing and maintaining incident updates based on changing internal or external conditions, including those related to patient tracking (Patient Tracking Manager) and bed tracking (Bed Tracking Manager);
2. The *Resources Unit*, which is responsible for tracking the status of personnel (Personnel Tracking Manager) and all material resources (Materials Tracking Manager) that are being utilized in various locations of the hospital;
3. The *Documentation Unit*, which is responsible for the completion and archiving of all IAPs and other incident documentation; and
4. The *Demobilization Unit*, which is responsible for developing and coordinating a demobilization plan.

The *Finance and Administration Section* is tasked with tracking all costs associated with the responses. Multiple sources contribute to these costs, including overtime, loss of revenue-generating activities, and repair, replacement, and/ or re-building expenses. In addition to its patient costs, the healthcare facility's vendor expenses, mutual aid financial remuneration, and personnel claims must be accounted for and processed in a timely manner, and in accordance with local, state, and federal guidance. Positions within the Finance/Administration Section may include the following Units, each under the direction of a Leader:

1. The *Time Unit*, which is responsible for coordinating all personnel time;
2. The *Procurement Unit*, which is responsible for ordering items and initiating contracts;
3. The *Compensation/Claims Unit*, which is responsible for arranging personnel-related payments and Workers' Compensation; and
4. The *Cost Unit*, which is responsible for tracking all response and recovery costs and payment of invoices.

HICS Components

Inherent in the design and flexibility of the HICS is the healthcare facility's option to combine command positions, when needed, to account for the limited availability of trained personnel, particularly at the outset of an incident or during off-hours. To ensure that healthcare facilities have the personnel needed for extended operations, healthcare facilities are encouraged to identify and train three–five persons capable of performing in each position.

Accompanying each Incident Management Team position is a Job Action Sheet (JAS) (Figure 10.2) that concisely reiterates the response mission and identifies what job is to be accomplished and when, and to whom it must be reported. JASs exist for all 78 positions within the Incident Management Team and are formatted according to designated time periods: Immediate [0–2 hours]; Intermediate [2–12 hours]; Extended [>12 hours]; and Demobilization and System Restoration. The Job Action Sheets (JAS) is intended to prompt action and integrated decision-making as well as assist with documentation.

A critical component of the HICS is documentation. To facilitate documentation, the HICS materials contain 20 documentation forms; 13 of these forms are from the US Federal Emergency Management Agency (FEMA) and are relevant to healthcare facility operations; and seven forms have been specifically crafted to meet those hospital documentation needs that are not covered by the FEMA forms. All of the forms can be completed manually or on a computer. Because of their importance or because of the type of information they contain, several of the forms will be completed more frequently than others (e.g., HICS 201 — Incident Briefing and HICS 214 — Operational Log Forms). The use of these standardized forms is intended to assist with decision-making, ensure essential documentation is completed, and share information among the Incident Management Team and with external response partners.

New to the HICS are 27 Incident Action Planning Guides to help in writing EOP annexes for 14 external and 13 internal scenarios, as well as Incident Response Guides to help command personnel with the unique decision making challenges associated with each of these situations. Also included in the HICS materials is a series of PowerPoint-formatted educational modules highlighting key information from each of the six chapters in the *Hospital Incident Command Center Guidebook* along with instructions on Incident Action Planning, Incident Planning, and Incident Response Guides and Forms. These materials are available at [www.emsa.ca.gov/hics/hics% 20guidebook%20and%20glossary.pdf](http://www.emsa.ca.gov/hics/hics%20guidebook%20and%20glossary.pdf).

HOSPITAL COMMAND CENTER (HCC)

The Hospital Command Center (HCC) is the physical location where the Incident Management Team convenes to make decisions, communicate, and coordinate the various activities of the healthcare facility's response to an incident. The HCC should be in a central location, out of the Emergency Department. Each healthcare facility should have a primary and a back-up command center location identified in their EOP; the back-up HCC is to be used when the primary site is not available.

Key design features for the HCC include easy accessibility and a secure location, preferably with an isolated entry, suitable in size to accommodate the desired number of command personnel, and able to contain and provide the functional requirements of a variety of redundant technology (i.e., telephones,

INCIDENT COMMANDER

MISSION: Organize and direct the Hospital Command Center (HCC). Give overall strategic direction for hospital incident management and support activities, including emergency response and recovery. Authorize total facility evacuation if warranted.

Date: _____ Start: _____ End: _____ Position assigned to: _____

Signature: _____ Initial: _____

Hospital Command Center (HCC) Location: _____ Telephone: _____

Fax: _____ Other Contact Info: _____ Radio Title: _____

Immediate (Operational Period 0–2 Hours)	Time	Initial
Assume role of Incident Commander and activate the Hospital Incident Command System (HICS).		
Read this entire Job Action Sheet and put on position identification.		
Notify your usual supervisor and the hospital Chief Executive Officer, or designee, of the incident activation of HICS and your HICS assignment.		
Initiate the Incident Briefing Form (HICS Form 201) and include the following information: • Nature of the problem (incident type, victim count, injury/illness type, etc.); • Safety of staff, patients, and visitors; • Risks to personnel and need for protective equipment; • Risks to the facility; • Need for decontamination; • Estimated duration of incident; • Need for modifying daily operations; • HICS team required to manage the incident; • Need to open up the HCC; • Overall community response actions being taken; and • Status of local, county, and state Emergency Operations Centers (EOC).		
Contact hospital operator and initiate hospital's Emergency Operations Plan.		
Determine need for appropriately appointed Command Staff and Section Chiefs, or Branch/Unit/Team leaders and Medical/Technical Specialists as needed; distribute corresponding Job Action Sheets and position identification. Assign or complete the Branch Assignment List (HICS Form 204), as appropriate.		
Brief all appointed staff of the nature of the problem, immediate critical issues and initial plan of action. Designate time for next briefing.		
Assign one or more clerical personnel from current staffing or make a request for staff to the Labor Pool and Credentialing Unit Leader, if activated, to function as the HCC recorder(s).		
Distribute the Section Personnel Time Sheet (HICS Form 252) to Command Staff and Medical/Technical Specialist assigned to Command, and ensure time is recorded appropriately. Submit the Section Personnel Time Sheet to the Finance/Administration Section's Time Unit Leader at the completion of a shift or at the end of each operational period.		
Initiate the Incident Action Plan (IAP) Safety Analysis (HICS Form 261) to document hazards and define mitigation.		

Figure 10.2A: Incident Commander Job Action Sheet

Immediate (Operational Period 0–2 Hours)	Time	Initial
Receive status reports from, and develop an IAP with, Section Chiefs and Command Staff to determine appropriate response and recovery levels. During initial briefing/status reports, discover the following: • If applicable, receive initial facility damage survey report from Logistics Section Chief and evaluate the need for evacuation; • If applicable, obtain patient census and status from Planning Section Chief, and request a hospital-wide projection report for 4, 8, 12, 24, and 48 hours from time of incident onset. Adjust projections as necessary; • Identify the operational periods and HHC shift change; • If additional beds are needed, authorize a patient prioritization assessment for the purposes of designating appropriate early discharge; • Ensure that appropriate contact with outside agencies has been established and facility status and resource information have been provided through the Liaison Officer; • Seek information from Section Chiefs regarding current “on-hand” resources of medical equipment, supplies, medications, food, and water as indicated by the incident; and • Review security and facility surge capacity and capability plans as appropriate.		
Document all key activities, actions, and decisions in an Operation Log (HICS Form 214) on a continual basis.		
Document all communications (internal and external) on an Incident Message Form (HICS Form 213). Provide a copy of the Incident Message Form to the Documentation Unit.		
Intermediate (Operational Period 2–12 Hours)	Time	Initial
Authorize resources as needed or requested by Command Staff.		
Designate regular briefings with Command Staff/Section Chiefs to identify and plan for: • Update of current situation/response and status of other area hospitals, emergency management/local emergency operation centers, and public health officials and other community response agencies; • Deployment of a Liaison Officer to EOC; • Deployment of a Public Information Officer (PIO) to the local Joint Information Center; • Critical facility and patient care issues; • Hospital operational support issues; • Risk communication and situation updates to staff; • Implementation of hospital surge capacity and capability plans; • Ensure patient tracking system is established and linked with appropriate outside agencies and/or local EOC; • Family Support Center operations; • Public information, risk communication and education needs; • Appropriate use and activation of safety practices and procedures; • Enhanced staff protection measures as appropriate; • Media relations and briefings; • Staff and family support; and • Development, review, and/or revision of the IAP, or elements of the IAP.		
Oversee and approve revision of the IAP developed by the Planning Section Chief. Ensure that the approved plan is communicated to all Command Staff and Section Chiefs.		
Communicate facility and incident status and the IAP to CEO or designee, or to other executives and/or members of the Board of Directors on a need-to-know basis.		

Figure 10.2B: Incident Commander Job Action Sheet

Extended (Operational Period Beyond 12 Hours)	Time	Initial
Ensure staff, patient, and media briefings are being conducted regularly.		
Review and revise the IAP Safety Analysis (HICS Form 261) and implement correction or mitigation strategies.		
Evaluate/re-evaluate need for deploying a Liaison Officer to the local EOC.		
Evaluate/re-evaluate need for deploying a PIO to the local Joint Information Center.		
Ensure incident action planning for each operational period and a reporting of the IAP at each shift change and briefing.		
Evaluate overall hospital operational status, and ensure critical issues are addressed.		
Review/revise the IAP with the Planning Section Chief for each operational period.		
Ensure continued communication with local, regional, and state response coordination centers and other HCCs through the Liaison Officer and others.		
Ensure your physical readiness, and that of the Command Staff and Section Chiefs, through proper nutrition, water intake, rest periods and relief, and stress management techniques.		
Observe all staff and volunteers for signs of stress and inappropriate behavior. Report concerns to the Employee Health and Well-being Unit Leader.		
Upon shift change, brief your replacement on the status of all ongoing operations, critical issues, relevant incident information and IAP for the next operational period.		
Demobilization/System Recovery	Time	Initial
Assess the plan developed by the Demobilization Unit Leader and approved by the Planning Section Chief for the gradual demobilization of the HCC and emergency operations according to the progression of the incident and facility/hospital status. Demobilize positions in the HCC and return personnel to their normal jobs as appropriate until the incident is resolved and there is a return to normal operations. • Brief staff, administration, and Board of Directors; • Approve announcement of "ALL CLEAR" when incident is no longer a critical safety threat or can be managed using normal hospital operations; • Ensure outside agencies are aware of status change; • Declare facility/hospital safety.		
Ensure demobilization of the HCC and restocking of supplies, as appropriate, including: • Return of borrowed equipment to appropriate location; • Replacement of broken or lost items; • Cleaning of HCC and facility; • Restocking of HCC supplies and equipment; • Environmental clean-up, as warranted		
Ensure that after-action activities are coordinated and completed including: • Collection of all HCC documentation by the Planning Section Chief; • Coordination and submission of response and recovery costs, and reimbursement documentation by the Finance/Administration and Planning Section Chiefs; • Staff debriefings to identify accomplishments, response, and improvement issues; • Identification of needed revisions to the Emergency Management Plan, Emergency		

Figure 10.2C: Incident Commander Job Action Sheet

Demobilization/System Recovery (continued)	Time	Initial
Operations Plan, Job Action Sheets, Operational Procedures, Records, and/or Related Items • Writing the facility/hospital After-Action Report and Improvement Plan; • Participating in external (community and governmental) meetings and other post-incident discussion and After-Action activities; • Post-incident media briefings and facility/hospital status updates; • Post-incident public education and information; • Stress management activities and services for staff.		
Documentation/Tools	Time	Initial
• Incident Action Plan • HICA Form 201 — Incident Briefing Form • HICA Form 204 — Branch Assignment List • HICA Form 207 — Incident Management Team Chart • HICA Form 213 — Incident Message Form • HICA Form 214 — Operational Log • HICA Form 252 — Section Personnel Time Sheet • HICA Form 261 — Incident Action Plan Safety Analysis • Hospital emergency operations plan and other plans as cited in the Job Action Sheet • Hospital organization chart • Hospital telephone directory • Radio/satellite telephone		

Figure 10.2D: Incident Commander Job Action Sheet

fax machines, computers, copiers) and administrative support materials (pens, paper, forms, stapler) to allow for dependable information recording and sharing. A clock and white boards or projected wall images should be available to display information in a timely and easily-readable manner. A television or computer is useful to obtain local and national news updates. The facility design should provide adequate work space for each person and a meeting area for the group. It is important that the HCC have its maintenance needs met (i.e., food, trash pick-up) on a regular basis, particularly in situations that are prolonged. Storing each command position's materials in bags or wheeled cases allows quick transfer to the back-up HCC, if needed.

Only authorized personnel should be allowed into the HCC. Each person should be physically identifiable as to their command role (facilities often used color-coded vests) and have computer and/or print access to the EOP, as well as various forms and other identified resources identified in the Tools and Documents Section at the bottom of their Job Action Sheet. Replacement materials should be readily available when needed.

At the change of each shift, on-coming personnel receive a situational briefing from the Incident Commander using the IAP created for their shift. Individual position briefings also occur as the off-going shift shares other important information with their on-coming replacement. During the operational period, the Incident Commander or Planning Section Chief leads oper-

ations meetings or situational briefings as needed, with progress reports occurring every 15 to 20 minutes. The details of these meetings are recorded by the Planning Section Chief, or designee, and shared with others within the healthcare facility via print, e-mail, or other means deemed by the Incident Commander. Regularly apprising the staff of the situation, the healthcare facility's responses, and other germane information are critical to maintaining staff confidence and trust in those in charge.

NATIONAL INCIDENT MANAGEMENT SYSTEM

In February 2003, the United States issued The Homeland Security Presidential Directive-5 (HSPD-5), which created the National Incident Management System (NIMS).^{2,3} The NIMS provides a standard template for governmental, private sector, and non-governmental organizations to use to work together during any type of incident or hazard situation. It is designed to provide a framework for interoperability and compatibility among the various members of the response community. The result is a flexible framework that facilitates governmental and non-governmental agencies working together at all levels (local, state, and federal) to mitigate and recover from an incident regardless of its size, type, or location.

The NIMS incident management structure is based on three key organizational systems:

- The *Incident Command System (ICS)*, which defines the operating characteristics, management components, and structure of an incident management organization for the duration of an incident;
- The *Multiagency Coordination System (MAC)*, which defines the operating characteristics, management components, and organizational structure of entities providing support to the responders; and
- The *Public Information System (PIS)*, which includes the processes, procedures, and systems for communicating timely and accurate risk communication and educational information to the public.

These systems stress the importance to all hospital and healthcare systems, both within and outside the United States, of developing an incident command system, an ability to communicate and work cohesively with all levels of responders, and a channel for providing consistent and timely information to the public.

The US Department of Health and Human Services gave hospitals and healthcare organizations 17 NIMS compliance elements to meet by September 2008. In 2008, this expectation was reduced to 14 NIMS compliance elements and the

deadline to achieve this was extended to September 2009. Patterned after the original expectations placed on governments, the hospital NIMS guidelines expects hospitals to embrace NIMS principles in their EOP, training and exercising, and to use an ICS that is consistent with the one used in their community. Healthcare facilities also are to participate in public information dissemination through the use of a Joint Information System that can activate a Joint Information Center during an incident, when needed. These joint agency efforts result in information-sharing across agencies and in consistent and improved communication to the public. In addition, NIMS also expects that all response terminology employed by hospitals and healthcare organizations be similar to that used within their community to avoid confusion or misunderstanding. Failure to be compliant in meeting the NIMS compliance expectations risks increased liability, and potential ineligibility for future federal funding.

PUBLIC HEALTH INCIDENT COMMAND

Public Health agencies increasingly have become engaged in emergency preparedness efforts to support local, state, federal, and international health systems in public emergencies. Included among their preparations are increasing the working relationships they share with healthcare facilities and collaborating on joint planning, training, and exercises. Like healthcare facilities, these agencies should use an ICS to define the role, responsibilities, chain of command, and job title of those involved in performing a function necessary to manage their response to an incident. Their responsibilities include providing staff to the EOC (local or state) to coordinate all health and medical issues related to the incident, including those faced by healthcare facilities. The Public Health personnel are responsible for information collection and dissemination, and for resource coordination among the various elements of the healthcare system.

Public Health agencies typically assign staff to the Local Emergency Operations Center while also assigning other personnel to their own Public Health Command Post, usually operated at a separate location. At this location, staff are assigned to roles appropriate to meeting the agencies' responsibilities for the type of incident. Command positions commonly assigned include Incident Commander, Primary Incident Officer, and the four Section Chiefs; subordinate officers can be assigned based on need and available resources. When an infectious disease is the basis for the incident, the administration of medications or immunizations/vaccinations usually is coordinated by Public Health staff at one or more Point of Distribution Center (POD). Each POD also has its own ICS personnel and chain of command. Whether at the EOC, Public Health EOC, or the POD, those in charge should wear identifying garb (e.g., colored vests), refer to the Job Action Sheet to assist

with decision-making, and complete standardized forms, including some of those used by healthcare facilities and other responders.

ICS IN BED UTILIZATION AT A NEW YORK CITY HOSPITAL ON 9/11

On 11 September 2001, St. Vincent's Hospital, a 550-bed hospital located in Manhattan, New York, established an ICS in response to the terrorist attack on the World Trade Center. Coordination of bed availability was placed under the control of three ICS positions: (1) the Medical Command Officer; (2) the Operations Officer; and 3) the Data Officer. These officers accessed the status of the hospital's critical care beds and staffing and oversaw the adaptation of other patient care areas into critical care areas, thereby creating four critical care units within the hospital. Attending physicians also were able to open 15 critical care beds by identifying patients that were able to be transferred to medical/surgical wards.⁸

Robert Powers

CONCLUSION

An ICS is a method of safely managing the responses needed in a crisis or disaster. The HICS is not a disaster plan, but, rather, the method by which the hospital will operate when an emergency is declared and standard operations are insufficient. Through roles with clearly identified responsibilities, and the flexibility to implement and expand the roles as needed, the hospital can adjust its incident command response based on the needs resulting from the disaster. Using standardized roles, such as those in the Hospital Incident Command System, improves communication through a common language, allows staff to move from one hospital to another, and facilitates all responders to understand the established chain of command.

Understanding Incident Command can improve the contribution that healthcare facilities provide when the scale of the response dictates the implementation of a LEOC, or when an event necessitates a Unified Command approach. Incorporation of incident command into healthcare practice can assist in the coordination of the response and in healthcare's integration into overall community response. The ICS has become utilized universally for the safe management of a crisis incident. Hospitals in Turkey implemented this approach after their experience with the earthquakes in 2000;⁵ and the Severe Acute Respiratory Syndrome (SARS) outbreak of 2003 prompted a Taiwan hospital to adopt this same management system.^{6,7}

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CHAPTER 11

CHEMICAL PREPAREDNESS AND RESPONSE

Yukiya Hakozaki

VICTIMS OF A CHEMICAL EXPOSURE resulting from a terrorist event or industrial accident may arrive at healthcare facilities in large or small numbers. In one study,¹ 47% of responding hospitals reported receiving an average of 2.4 chemically contaminated patients over a 12-month period, while the Tokyo, Japan, sarin attack brought 5,500 potentially exposed persons to area hospitals within a short period of time.² The early diagnosis and treatment of victims of a chemical agent exposure are necessary to limit or prevent injury to these victims as well as to the healthcare staff, and also to prevent contamination of the receiving healthcare facility.

OBJECTIVES:

- Describe the symptoms and treatment of victims of the various chemical agents;
- Understand the key aspects of healthcare facility preparedness and its response to chemical incidents; and
- Describe the types of chemical incidents and the risks they pose for healthcare.

However, many hospitals lack appropriate preparedness for a chemical incident. One Canadian study found that only 30% of responding hospital emergency departments (EDs) had a decontamination area or had plans to build one.³ A US study found that only close to 30% of participating hospitals considered their decontamination processing ability to be >10 patients per hour.⁴ An Australian study revealed a lack of minimum hospital standards for chemical agent preparedness; 38% of the hospitals provided no chemical response training for healthcare staff; and 30% of the hospitals had never tested their chemical incident response plan.⁵

In order to detect chemical incidents early, hospital staff must have sufficient knowledge to suspect and recognize the signs and symptoms of a

chemical exposure. This knowledge must be accompanied by an efficient, detailed, response plan that can be implemented quickly by frontline staff. Hospital preparedness for chemical incidents also requires the availability and rapid acquisition of appropriate antidotes, personal protection equipment (PPE), decontamination equipment, as well as staff who are well-versed in the use of such equipment, and coordination of first-responder efforts with those of the receiving healthcare facility. Education, training, planning, and drills involving all staff are indispensable to the healthcare facility's chemical response capability.

CHEMICAL INCIDENTS

Chemicals are used throughout the world in a variety of industrial settings, including the manufacturing, agricultural, medical, and service sectors. Chemicals are transported daily by tractor-trailer, ship, plane, and even local mail delivery services. Chemicals also are used widely in homes. If used or released improperly, i.e., via an accidental or intentional release, many chemicals can be hazardous to humans causing death, serious injury, and/or long-lasting health effects.⁶

A variety of chemical incidents have impacted healthcare facilities with the arrival of large numbers of chemically exposed victims. Classified as the world's worst chemical incident, the chemical release of methyl isocyanate, phosgene, and cyanide in Bhopal, India in 1984, resulted in >80,000 victims and 3,000 deaths.⁷ In 1987, hydrofluoric acid was released accidentally from a plant in Texas, the United States, resulting in 939 victims (in a town with a population of 41,000) presenting to local hospitals.⁷ In 1997, devices containing chlorine were released by terrorists at two locations in Sydney, Australia,⁵ and two incidents of chemical releases by terrorists have occurred in Japan.

CHEMICAL TERRORISM

Chemical warfare agents are specific, hazardous chemicals developed by the military that could be released by terrorists in an attempt to cause a harmful medical, economic, and emotional impact on the community. The development, production, and use of chemical warfare agents are prohibited by international treaties to which most World Health Organization member states have subscribed through the 1993 Chemical Weapons Convention. However, chemical weapons could be obtained through theft, from states sponsoring terrorism, or through black marketers selling weapons, such as those believed to be missing after the break-up of the former Soviet Union.⁸

There also are many toxic chemicals (e.g., chlorine and ammonia) that are used legitimately in industrial, research, or university settings and that could be used as weapons by terrorists. Chemicals that terrorists would likely attempt to

use are based on their ease of procurement or the ease of self-manufacturing the chemical in a makeshift laboratory. To increase the lethality of their efforts and to improve the ease of transporting the needed quantity without detection, terrorists try to use the chemical with the greatest toxicity at the lowest dose.

Inherent barriers to an effective (i.e., causing high fatality) dispersal of a chemical include the difficulty in creating and sustaining a chemical with a sufficiently high concentration in the air to cause widespread exposure. Factors influencing the casualty rate from chemical exposure include:⁷

1. Physical form;
2. Evaporative rate and density;
3. Droplet size;
4. Volume and purity;
5. Environmental conditions; and
6. Air filtration systems (for indoor events).

Of the physical forms of a chemical agent, (i.e., water, solid, liquid or gas), the gaseous vapor or aerosol form is most apt to result in widespread exposure. Chemical weapons in this form increase the potential lethality of the agent, as evidenced in both of the chemical attacks in Japan and Sydney, Australia.^{2,5} Aerosolization can be accomplished through mechanical means (such as the hand sprayers used in the terrorist event in Matsumoto, Japan), or with a heater and a fan, or without any assistance if the chemical has a sufficiently high spontaneous vaporization rate.⁵

CHEMICAL RISKS

Exposure to chemical agents can occur through inhalation, absorption, ingestion, and injection. In general, exposure occurs primarily through the respiratory tract and the skin. The severity of the exposure is based on the:⁹

1. Concentration of the chemical;
2. Quantity of the chemical;
3. Duration of contact; and
4. Type of exposure.

Primary contamination is the exposure caused by direct contact with the contaminant. Secondary contamination is the exposure caused by contact with contaminated items, e.g., the victim or the victim's clothing. Most chemical exposure that occurs in the hospital setting occurs through secondary contamination as the primary contaminant is at the scene of the event. "Off-gassing" refers to chemical residue remaining on the exposed victim's skin or clothing that still can be vaporizing upon the victim's arrival to the hospital; this presents a safety issue to hospital staff. The staff at St. Luke's Hospital in Tokyo performed no decontamination of the arriving sarin-exposed victims from the Tokyo subways, and cared for patients without wearing chemical suits or res-

pirators; the resultant off-gassing caused the development of signs of exposure in 110 hospital staff members.² Potential exposure due to off-gassing emphasizes the importance of: (1) performing decontamination procedures before victims enter the hospital; and (2) staff wearing the appropriate level of PPE, i.e., a chemical suit and respirator.

CHEMICAL AGENTS

The lethal chemicals known to have been developed into chemical warfare agents may be divided into two groups: (1) systemic poisons and (2) tissue irritants. The first group is comprised of the blister agents and the nerve agents, while the second group consists of the choking gases (lung irritants or asphyxiants) and the blood gases.¹⁰

Systemic Poisons

Nerve Agents

The term “nerve gas” or “nerve agent” is used for organophosphorus and other organophosphate compounds because of their direct effect on human nerve cells. Specifically, the effects of both nerve agents and organophosphate insecticides are related to the inhibition of tissue cholinesterase at synaptic sites, and to the accumulation of excessive amounts of acetylcholine at nicotinic and muscarinic receptors in effector organs resulting in overstimulation of muscles and organs.

At the present time, the two families of nerve gases are the G agents (sarin, Tabun, and Soman) and the V agents (VX and Vx). The G agents tend to be non-persistent and primarily are designed to act via inhalation, while the V agents are persistent and act primarily through skin penetration as well as through inhalation of the aerosol.¹⁰ Sarin is an odorless nerve agent, whereas Soman and Tabun have a fruity odor.⁹ Sarin is the most volatile of the agents, and, thus, has the highest vapor hazard of the nerve agents.¹¹ When dispersed as a vapor or aerosol, or when absorbed on dust, all of the nerve agents are absorbed readily and completely via the respiratory tract and the eyes.

Miosis is a characteristic sign in adults exposed to a nerve agent vapor and often is accompanied by the complaint of blurred vision; however, miosis does not occur in children exposed to nerve gas. Other characteristic symptoms of nerve agent exposure include salivation, lacrimation, urination, defecation, and gastric emesis (often given the acronym “SLUDGE”). Symptoms are related directly to the amount and type of exposure (vapor versus liquid) the victim experienced. Without treatment, death can occur as a result of anoxia from airway obstruction, muscle fatigue, and central nervous system depression.

Vapor exposure can result in absorption within seconds and, with lethal doses, can cause death within minutes of exposure.⁹ Non-symptomatic victims

who have experienced a chemical vapor exposure may be able to be discharged from the healthcare facility after one hour of observation, as there is no delay in symptom development. However, victims who have sustained dermal exposure to a nerve agent can experience a delay in symptom development of up to 18 hours following exposure.¹¹ Exposure to large amounts of nerve agents can result in seizures, coma, and apnea within 1–30 minutes of exposure.¹¹ The measurement of decreased cholinesterase activity in blood is the only method currently available for the rapid diagnosis of nerve agent exposure.

Anticholinergic and anticonvulsant agents constitute drug therapy for symptomatic victims of nerve agent exposure. Diazepam is utilized for both therapeutic and prophylactic seizure control. The anticholinergic agent atropine sulfate blocks the muscarinic effects in the periphery, and partially counteracts the agent's convulsive effects and respiratory depression. Pralidoxime (also known as "2-PAM") severs the bond between the nerve agent and the cholinesterase, allowing a reduction in accumulated acetylcholine, and an accompanying reduction in the skeletal muscle (nicotinic) effects of the exposure.⁹ However, "aging" of the nerve agent produces an irreversible bond between the nerve agent and cholinesterase; this aging occurs within <2 minutes of exposure to Soman, and within 5 hours of exposure to Sarin.¹² Both atropine and 2-PAM reactivate acetylcholinesterase bound by the nerve agent and, thus, relieve some of the symptoms associated with skeletal neuromuscular blockade. However, these agents penetrate poorly into the central nervous system.

Atropine and 2-PAM are combined in a dual syringe, spring-loaded auto-injector known as the MARK 1 kit (Figure 11.1). Developed by the military for intramuscular self-administration of the agents, the kits are available commercially, and are stored by many ambulance services and healthcare facilities for rapid administration to large numbers of victims. However, the doses of the agents in the Mark 1 kit represent adult doses and are not suitable for pediatric victims. Although evidence is lacking, doses of these agents based on a child's weight, age, and severity of nerve agent exposure have been suggested.¹²

Treatment after nerve agent exposure is based on the severity of symptoms. The clinician determines the probable level of exposure (mild, moderate, or severe) and follows pre-established medical management guidelines (Figure 11.2). Immediate treatment for arriving exposed victims also includes decontamination. (See Chapter 15 for decontamination guidelines.)

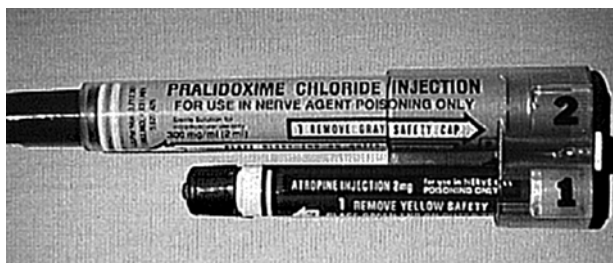


Figure 11.1: Mark 1 kit with agents used in treating chemical exposure to nerve agents

Blister Agents

The vesicants, or blister agents, are general tissue irritants that can cause inhalation and dermal injury, provoking blistering at the affected site of contact. Blister agents can penetrate clothing.

Mustard gas

Mustard gas is a colorless or slightly amber, oily liquid with a pungent odor resembling that of horseradish mustard or garlic. Exposure can occur via inhala-

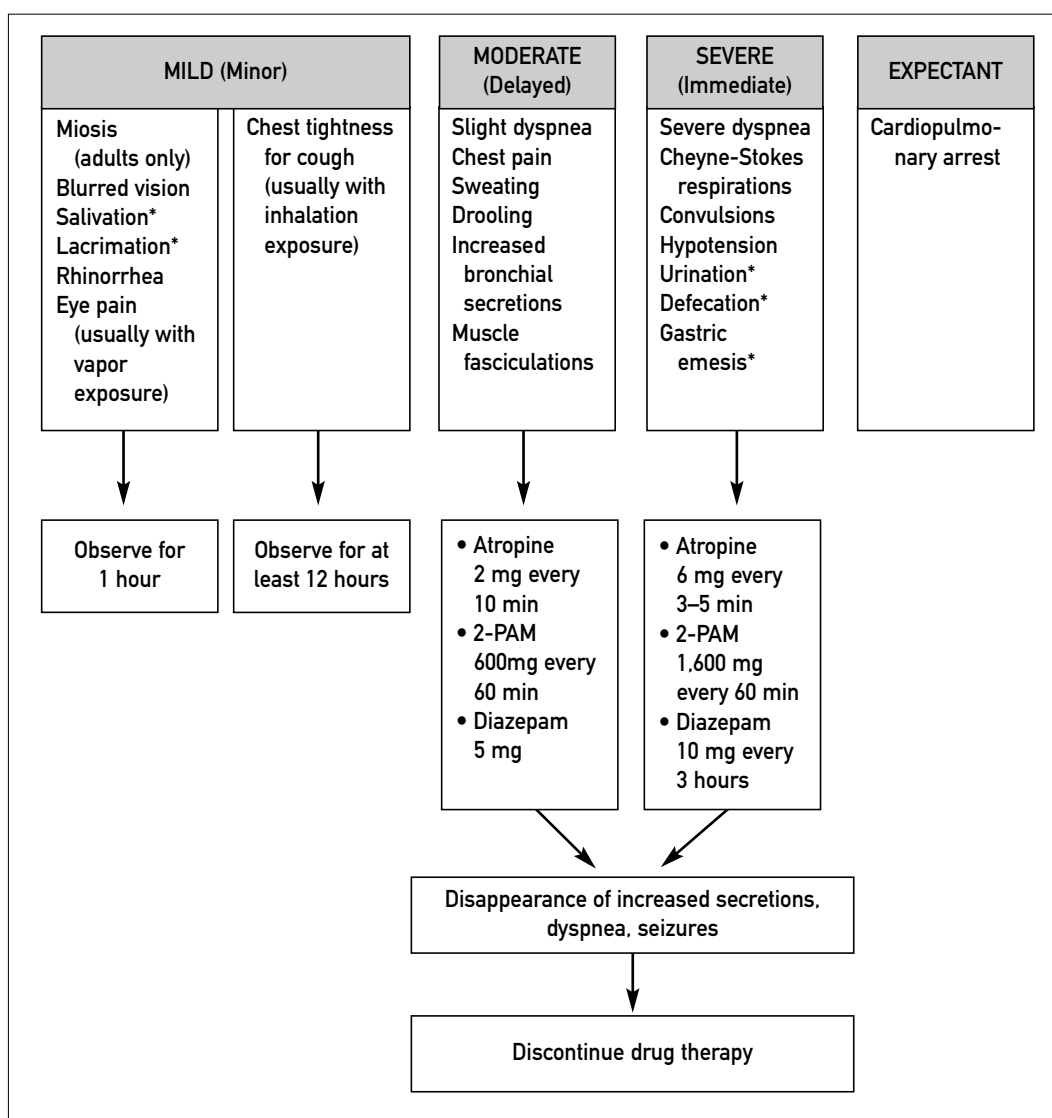


Figure 11.2: Triage and treatment of victims of nerve agent exposure (min = minutes; mg = milligrams) *Characteristic symptoms of excretion following nerve agent exposure are salivation, lacrimation, urination, defecation, and gastric emesis (SLUDGE)

tion and skin contact. There are no immediate symptoms of exposure to this agent. The first symptoms generally are related to eye exposure and occur within 30 minutes to three hours after exposure. Mild-to-moderate ocular exposure may produce irritation, redness, pain, and swelling of the eyes, while more intense exposure can produce extreme pain and temporary blindness.¹³ Between four and 16 hours after exposure to mustard gas, victims of mild exposure likely will experience increased nasal secretions, sneezing, sore throat, coughing, and hoarseness. Most patients with mild exposure to mustard gas recover rapidly.

Symptoms of substantial mustard gas exposure include the development of stridor and dyspnea; inflammation of the upper and lower respiratory tracts becomes evident during the second day after exposure. Secondary infection of the necrotic respiratory membranes may terminate in bronchopneumonia, with death occurring any time between the second day and the fourth week after exposure. Severe mustard gas exposure also affects the skin, producing an itch and a skin rash that may present as an erythema on the exposed parts of the body. The development and size of the blisters depend on the degree of exposure; blisters are more severe in children than in adults. Blisters caused by mustard gas may heal in two or three weeks, while full-thickness skin erosions usually heal in six to 12 weeks after exposure.

Prophylaxis against exposure to mustard gas depends entirely on adequate protection of the skin and airways by protective garments worn at the time of exposure. There are no specific antidotes, and treatment is supportive and symptom-driven.¹⁴ The skin blisters caused by this agent are extremely painful and require treatment with appropriate pain medications. Early intubation and mechanical ventilation with positive end-expiratory pressure (PEEP) may be helpful in patients who develop respiratory symptoms.

Lewisite

Lewisite is an odorless, colorless, oily liquid; exposure occurs via inhalation and by skin contact. Lewisite causes increased capillary permeability, which can lead to hypovolemia, hypotension, hypoperfusion, and organ damage.

The latency period from lewisite exposure to the development of symptoms is shorter than that of mustard gas. Skin contact with this agent produces an immediate burning sensation followed within 15–30 minutes by painful erythema, and, within a few hours, by skin vesication. Maximum blistering occurs approximately four days after exposure.¹⁵

Although the time frame from exposure to onset of symptoms differs, lewisite exposure is associated with a clinical picture that is similar to that of mustard gas. Victims experience immediate eye irritation, lacrimation, blepharospasm, and eyelid swelling, followed rapidly by airway irritation signs, including rhinorrhea, coughing, sneezing, throat pain, and hoarseness; dyspnea

and pulmonary edema may occur in severe cases. Systemic effects are those of arsenic toxicity and include nausea, vomiting, diarrhea, neuropathy, renal failure, hemolysis, and encephalopathy.¹⁵ Hemolytic or hypovolemic shock also may occur.

No prophylactic treatment against lewisite is available. After exposure, dimercaprol (British anti-lewisite or “BAL”) is the standard treatment of victims with systemic effects. The indications for systemic treatment following lewisite exposure by any route are:¹⁶

1. Cough with dyspnea and frothy or blood-tinged sputum or other signs of pulmonary edema;
2. Skin burn the size of the palm of the hand or larger, which was not decontaminated within the first 15 minutes of exposure; and
3. Skin contamination of >5% of the body surface, with evidence of immediate damage, such as grey or dead-white blanching of the skin, or erythema.

The dosing regimen of BAL treatment is 2.5 milligrams/kilograms via deep intramuscular injection, every 4 hours for four doses, followed by 2.5 milligrams/kilograms twice daily. Based on the level of toxicity, this treatment can continue for two to 10 days. However, BAL does contain peanut oil and, therefore, should be used with extreme caution in patients with peanut allergy.¹⁷

Treatment with BAL should be utilized only for severe exposures in victims presenting with pulmonary edema or shock.¹⁶ Meso-2,3-dimercaptosuccinic acid (DMSA) and 2,3-dimercapto-1-propanesulfonic acid (DMPS), chemical compounds that are similar to BAL, have become available, are less toxic than BAL, and can be administered orally rather than intramuscularly.

Tissue Irritants

Both lung irritants and the blood gases can decrease oxygen supply by displacing available oxygen or interfering with cellular oxygen delivery, and also can cause direct injury, including burns and edema, to the eyes, airway, lungs, and exposed skin.

Lung Irritants

Lung irritants include phosgene and chlorine, agents that can cause life-threatening injury to the lungs after exposure. Phosgene is a colorless gas at most ambient temperatures, and is described variously as having the odor of decaying fruit, freshly cut grass, or moldy hay. Chlorine is greenish-yellow in color and has a pungent odor. At low concentrations, both of these agents produce burning and watering of the eyes, a sore or scratchy throat, dry cough, and chest tightness. These latter symptoms are rough indicators of the possibility of the development of more severe lung injury. Pulmonary edema may develop

following moderate-to-severe exposure; its development within four hours after exposure is associated with a poor outcome. At very high concentrations, phosgene causes hemolysis within the pulmonary capillaries, with congestion and blockage of capillary circulation; death occurs within a few minutes from acute cor pulmonale.

Victims of lung irritant gases should be removed from the source of exposure and undergo rapid decontamination, as the agent can be absorbed within seconds. Patients should be provided warmth, rest, and quiet; any exertion can lead to more pronounced symptoms. All victims of lung irritant exposure should be observed for up to 48 hours for the potential delayed onset of symptoms. Early intubation and mechanical ventilation are essential at the first sign of pulmonary edema or pulmonary failure.

Blood gases

Lethal chemical agents, such as arsine and cyanide, interfere with cell respiration and have come to be known as “blood gases”. The key agent is hydrogen cyanide, a toxic industrial chemical that also has been used as a chemical warfare agent by the Nazis during the Holocaust, and by the Iraqis against the Kurds in the 1980s.¹⁸

Some people can smell hydrogen cyanide (HCN) at low concentrations, describing an aroma of bitter almonds. Inhalation is the primary route of exposure, although direct contact with the liquid can result in exposure through absorption. Hydrogen cyanide is a rapid-acting, lethal agent that inhibits aerobic respiration at the cellular level, preventing cells from utilizing oxygen.

With exposure to low concentrations, symptoms may appear and increase in severity over an hour or longer. Victims notice an immediate and progressive sense of warmth (due to vasodilatation) with visible flushing; other symptoms at low doses include dizziness, headache, and confusion, along with mild airway and mucus membrane irritation.

Due to the body’s attempt to increase blood oxygen concentration, severe “air hunger” with tachypnea often are the principal initial symptoms in victims exposed to high concentrations of HCN.¹¹ These may be followed by convulsions and loss of consciousness with death resulting from cardiac and/or respiratory arrest. With exposure to high concentrations of HCN, respiratory failure may occur within two to three minutes. Caution should be taken by the healthcare providers as off-gassing via the patient’s respirations can result in staff exposure; additionally, contact with the exposed victim’s body fluids should be avoided.¹¹

The treatment of victims of HCN exposure includes the prompt administration of supplemental oxygen. Subsequent treatment is aimed at dissociating the cyanide ion from cytochrome oxidase, which allows the resumption of

cellular aerobic metabolism. Many hospitals, as well as manufacturers who use cyanide in industrial processes, commonly keep cyanide antidote kits on hand in the event of an exposure. Sometimes referred to as the Pasadena kit (formerly called the Lilly kit), these antidote kits contain three medications for cyanide exposure: Amyl Nitrite, Sodium Nitrite, and Sodium Thiosulfate. An Amyl Nitrite ampoule broken open, its contents poured onto a medical gauze, and the gauze placed next to the patient's mouth and nose for inhalation, alternating 30 seconds in place with 30 seconds off.¹¹ Sodium Nitrate is administered intravenously as 3 milliliters of a 10% solution over at least five minutes. Sodium Thiosulfate is administered intravenously in doses of one ampoule over 10–20 minutes.¹¹ Victims who are asymptomatic after exposure to cyanide do not require oxygen or antidote administration. Decontamination of exposed clothing or equipment is unnecessary with cyanide vapor exposure as HCN is very volatile and, thus, vaporizes rapidly. However, if skin or eye contact with HCN solids or liquids is suspected, decontamination should be performed.

Disabling Chemicals

Disabling chemicals have been used widely by police and other law forces for enforcement purposes. Sensory irritants, such as tear gases or sternutators, often are called “riot control agents”.¹⁹ Activation of these agents, lawfully or otherwise, could result in large numbers of victims seeking medical care. These agents could be used by terrorists to inflict panic or could be combined with other, more lethal, chemical agents in an attempt to compound the difficulty in correct agent identification and treatment by first-responders and hospital staff. The main types of disabling chemicals are Lysergide (LSD), Agent BZ, and Adamsite.

Lysergide (LSD)

Lysergide can be disseminated as a contaminant of food or water or as an inhalable aerosol. The first symptoms of LSD exposure usually are somatic and include mydriasis, dizziness, drowsiness, nausea, and paraesthesia, and occur within a few minutes after either oral ingestion or inhalation. Lysergide has a short half-life (approximately three hours) in humans. No specific antidotes exist. Patients should be removed from the source of exposure.

Agent BZ

Agent BZ is an anticholinergic compound similar both structurally and pharmacologically to atropine. Inhalation is the most likely exposure route, but BZ also is active via oral routes. Signs and symptoms of BZ exposure include increased heart rate and blood pressure, dry skin, blurred vision, disorientation, and confusion leading to stupor. In general, at milder doses, symptoms abate within 48 hours. The treatment of choice is physostigmine administration.

Adamsite

Adamsite is a yellow-to-brown crystalline solid without odor. The agent produces intense irritation to the nose, throat, and respiratory tract of exposed victims. Peripheral sensory nerves also are affected, and skin irritation may occur. At low doses, the upper respiratory tract is affected; lung irritation occurs at high doses. Difficulty breathing may be relieved by inhaling low concentrations of chlorine, e.g., breathing from a bottle of household bleach. Dust particles in the eye and on the skin should be removed by flushing with copious amounts of water. Treatment is symptom-driven.

CHEMICAL EVENT PREPAREDNESS AND RESPONSE

Hospital planning for chemical incidents should focus on preventing staff exposure, limiting patient exposure, and preventing facility contamination. These priorities can be accomplished through integration of the following procedures and recommendations regarding healthcare facility response to patients exposed to chemical agents.

Coordination with Field Response

The response to chemical incidents includes a large number of healthcare providers. Ambulance crews should know the locations of all local and regional hospital decontamination receiving areas, and practice the hand-off of contaminated patients. Firefighters and field Hazardous Materials (HazMat) Teams must practice interfacing with hospital EDs so that useful information related to agent identification, early description of symptoms, and details of the exposure, and level of field decontamination can be relayed effectively. Pre-established communication lines should be developed so that hospital personnel can talk directly to field HazMat Teams to ensure the proper relay of information.

Risk Analysis and Disaster Response Activation

The arrival of victims or an initial report from first-responder agencies alerts the hospital of a chemical incident within the community. The hospital staff rapidly must determine if activation of the decontamination response is necessary for the arriving victims. Multiple sources of information guide these decisions. Utilizing the established communication lines with field teams provides information regarding what procedures have been performed in the field, the results of any on-scene chemical analysis to identify the agent, and any expert guidance related to the risks of the particular chemical released.

If the agent has been identified, numerous medical management guidebooks can be utilized to provide response guidance, including the US Army's *Medical*

Management of Chemical Casualties Handbook, the *First Responder Chem-Bio Handbook*, and the North Atlantic Treaty Organization (NATO) handbook on the medical aspects of nuclear, biologic, and chemical (NBC) defensive operations.^{20–22} Chemical hotlines, such as the Chemical Transportation Emergency Center (CHEMTREC) Response Center in North America, can be contacted for specific chemical information. Pre-identified area experts on chemical agents, such as medical toxicologists from local poison control centers or other government agencies, can provide hospitals with other sources of guidance.

If the agent is unknown, the hospital should have a pre-established response plan that includes an automatic decontamination response. Without sufficient available information regarding the agent, it is best to respond as if the chemical poses a hazard until substantial incoming information proves otherwise.

Detection

Most healthcare providers have little or no experience with illnesses caused by chemical weapons and, therefore, may not suspect a chemical exposure, especially in the early phases. Compounding this difficulty is the high likelihood that victims will self-direct to hospitals without awaiting assistance from emergency medical services, and will arrive at the ED prior to the hospital's notification of the occurrence of a chemical incident. Both the lack of notification and improper early identification of the chemical agent occurred in Tokyo, where one of the receiving hospitals eventually learned of the field identification of the agent sarin via the news media.²

Often, it is the recognition of characteristic symptoms or the presentation of multiple victims with similar symptoms that provide the first indication to hospital staff that a chemical agent has been released. Staff must have sufficient training to know the signs and symptoms specific to each chemical agent, and maintain a high index of suspicion of potential exposures during routine triage. The clinical diagnosis, based on presenting signs and symptoms, and any history of the event obtained from arriving patients may be the only basis for determining the initial treatment of patients, as occurred with the Tokyo subway sarin attack.²³

The hospital staff's ability to detect the presence of chemical agents can be enhanced through the use of a variety of commercially available chemical detection materials. These materials range from military-type chemical paper capable of detecting liquid or vapor contamination, to hand-held vapor-detection meters and hazardous-material identification kits. Victims can be tested upon arrival at the hospital for the presence of chemicals or post-decontamination to ensure the effective removal of residual chemicals from the patient.

Specific diagnostic aids range from established techniques, such as the measurement of red blood cell acetylcholinesterase activity in victims suspected of nerve agent exposure, to newer, advanced techniques, such as the detection of

specific DNA adducts in suspected cases of mustard gas exposure. For more detailed detection capability, chemical assays of gas chromatography may be required. However, few hospitals are able to maintain these analytical methods independently. Ideally, every region should establish a reference laboratory or a network of laboratories capable of identifying chemical agents.

Triage in Chemical Events

Depending on the casualty load and the mechanism of the chemical, ED staff members performing triage may need to triage according to the level of chemical exposure symptoms the victims are exhibiting (e.g., mild, moderate, or severe) and by the significance of the resultant injuries. The rapid onset of effects associated with some chemical agents requires that triage and administration of antidotes occur simultaneously. Protocols for antidote administration based on presenting signs and symptoms must be pre-established to guide staff in determining the type and amount of antidote to be administered.

After a chemical release, it should be expected that the hospital will receive many individuals with mild or no symptoms; this influx adds another challenge to the hospital's response. Victims typically are unfamiliar with the risks involved in any level of exposure and assume hospital evaluation and care are necessary for all levels of exposure. In the Japan sarin events, 80–90% of presenting victims experienced mild or no symptoms.² In a hydrofluoric acid event in the state of Texas in the United States, 90% of the presenting victims were discharged from the ED, with 15% of the patients having no complaints.²⁴

A condition known as mass psychogenic illness (MPI) also may contribute to the presentation of persons without complaints or symptoms. In 1989, unfounded reports of a chemical release in Russia prompted more than 400 individuals to seek hospital care.²⁵ An MPI occurs during stressful events, particularly those involving substances with which the general public is unfamiliar, (e.g., chemical agents) and can affect large numbers of people; MPI causes symptoms such as headache, nausea, difficulty breathing, and/or chest pain.⁷ As these symptoms are similar to those of some chemical agents, it may be difficult to discern victims experiencing MPI symptoms from those experiencing chemical exposure effects. To guide triage, clinicians must weigh factors such as the proximity of the victim to the chemical release along with direct observance of objective signs of exposure. Victims with MPI, as well as those victims actually exposed, require psychological support provided at the hospital.

Decontamination

Decontamination is the most essential and specialized activity for the care of victims of chemical incidents. (See Chapter 15 for a complete discussion of decontamination methods.) Contaminated victims may reach hospitals by their own

means, bypassing on-site decontamination facilities, or decontamination may be performed at the hospitals rather than in the field in order to expedite “clearing” of the scene, as is done in the Israeli response model. Decontamination procedures at the hospital may be performed by community-based fire or hazardous material teams, by a specially trained decontamination response team of staff from throughout the hospital, or, least ideally, by the hospital ED staff. Regardless of the type of team utilized, hospitals must have a decontamination facility located near the hospital ED entrance that is capable of rapid implementation.

Personal Protective Equipment (PPE)

The danger of chemical agent exposure is low when contaminated victims initially arrive at a hospital. However, many hospitals have poor ventilation and lack a designated decontamination area; these factors increase the risk of exposure for staff, patients, and the hospital. After the Tokyo subway sarin attack, a survey of the St. Luke’s Hospital staff revealed that nurses and nursing assistants experienced a high incidence of secondary exposure, likely due to extended direct contact with the victims without wearing appropriate PPE (i.e., chemical suits and respirators) and failure to decontaminate the victims prior to their entry into the hospital.² PPE must be available to frontline hospital staff to allow them to carry out decontamination and treatment activities without becoming casualties themselves.

LONG-TERM HEALTH MONITORING

Some chemical agents have long-term effects that may manifest over a period of many years. Exposure to nerve agents can result in long-term neurological effects, such as impaired memory.⁹ Chronic bronchitis and oral cancer may result from mustard gas exposure. Organized and well-administered, long-term follow-up programs, along with rehabilitation programs, are necessary for the benefit of patients and staff exposed to chemical agents.

CONCLUSION

Hospital staff must be trained and prepared to diagnose and treat casualties of chemical incidents quickly. Familiarity with decontamination procedures and appropriate PPE use will positively impact both the well-being of the exposed victims and the ability of the hospital to maintain functionality by preventing hospital contamination and minimizing secondary exposure to the chemical agent by the staff. Hospital preparedness for chemical incidents requires staff education, training, and drills, and planning to ensure that the staff are efficient in the use of all necessary specialized equipment, antidotes, and PPE use. Planning also must integrate communication systems for seamless interaction with first-responders.

THERE HAVE BEEN TWO TERRORIST ATTACKS in Japan

involving the chemical agent sarin. These occurred in the cities of Matsumoto and Tokyo, and were carried out by the cult group Aum Shinrikyo.

In June 1994, in Matsumoto, the group used an improvised dissemination system to deliver sarin from the window of a disguised delivery van.²⁶ After a 20-minute release period, the gas spread throughout an elliptical area measuring approximately 800 by 570 meters. Seven residents of the nearest residential apartment building were killed. In the affected area, there were 54 event-related hospital admissions, and an additional 253 victims who sought care at outpatient facilities.



Photo courtesy of Dr. Yukiya Hakozaaki.

Figure 11.3: Victims being cared for outside a Tokyo subway station following the sarin attack in 1995.

On 20 March 1995, the same group used sarin to launch a coordinated attack on commuters on the Tokyo subway system resulting in 12 fatalities (Figure 11.3).² The terrorists placed bags filled with sarin (about 30% pure) on the floor of the train, pierced them with umbrella tips, and exited the trains several stations away from the Kasumigaseki station, where many Japanese government buildings are located. More than 5,000 people sought medical assistance; approximately 980 persons were mildly to moderately affected; and there were nearly 500 event-related hospital admissions. Additionally, 110 staff members working in the main receiving hospital in Tokyo received secondary exposure.

Lessons learned from this incident include the following:

- Many severely affected victims were transported to the one nearest hospital, rather than being dispersed among several area hospitals;
- Emergency decontamination facilities and protective equipment were lacking in the receiving hospitals;
- Hospitals lacked agent detection and identification capabilities (except for the chemical defense unit of the Japan Ground Self-defense Force); and
- The staff of the hospitals had not been educated and trained in the care of casualties of chemical weapons.²⁷

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CHAPTER 12

BIOLOGICAL PREPAREDNESS AND RESPONSE

Adrian Crowe

ALTHOUGH PUBLIC AWARENESS of the possible use of biological agents in a terrorist event has risen since events such as the anthrax attacks immediately following 9/11, its history is as long as that of warfare.¹ The use of biological agents includes medieval siege tactics in which human bodies infected with plague were catapulted over the walls of besieged cities, the assassination of Georgi Markov in London in 1978 using a ricin pellet fired from an umbrella, and the deliberate salmonella contamination of salad ingredients in Oregon in 1984 in the hope of deterring voter turnout in a local election.^{2,3}

OBJECTIVES:

- Understand the characteristics of a biological event and how its impact on a hospital differs from that of a conventional mass-casualty event;
- Describe the methods of detecting a biological event and the potential triggers; and
- Understand and describe the key aspects of biological agent preparedness and response for a healthcare facility.

Terrorist attacks using biological agents can be difficult to detect and can result in a larger and more sustained impact on healthcare facilities than that resulting from a conventional, rapid-onset, short-duration mass-casualty event. Although hospitals should be prepared for all hazards, there are specific preparedness and response measures for dealing with patients exposed to biological agents that must be incorporated into preparedness planning. For instance, the plan should detail procedures for stockpiling supplies, establishing screening centers and alternate care sites, providing decontamination areas and supplies, and altering staffing patterns to compensate for decreased numbers of available staff.

BIOLOGICAL AGENTS

Categories

Biological agents are toxins that can cause illness or death in exposed humans or animals. The US Centers for Disease Control and Prevention (CDC) prioritizes and assigns potential bioterrorism agents into categories A, B, or C, according to their ease of transmission and severity of effects.⁴

Category A agents include those biological agents that are disseminated or transmitted easily from person to person, have a high mortality rate and the potential for a major public health impact, may cause public panic and social disruption, and may require special preparedness activities. Agents in this category include anthrax, botulism, plague, smallpox, tularaemia, and hemorrhagic fever viruses, such as Marburg, Ebola, Lassa, and Machupo.

Category B agents include agents that are moderately easy to disseminate, cause moderate morbidity and low mortality, and require enhanced diagnostic surveillance capabilities. These agents include brucellosis, epsilon toxin of *Clostridium perfringens*, organisms that threaten food safety (e.g., salmonella and *E. coli* 157), glanders, melioidosis, psittacosis, Q fever, ricin, staphylococcal enterotoxin B, typhus, alphaviruses, and agents that threaten water safety (e.g., *Vibrio cholerae* and *Cryptosporidium parvum*).

Category C agents include the viruses of emerging diseases, such as the Nipah virus and the hantavirus, which pose a potential risk due to their ability to be engineered and produced for mass dissemination, and their ability to cause high morbidity and mortality rates.

An overview of potential biological agents is provided in Appendix 12A.

Specific Agents

The following biological agents are of particular concern due to their ease of transmission and associated potentially high fatality rates.

Anthrax (*bacillus anthracis*) is a large spore-forming, gram-positive rod, capable of causing three different clinical manifestations.

Cutaneous anthrax follows direct exposure to spores from sick animals or from the contaminated wool or hides of sick animals. Within one day following exposure, localized itching may occur. This develops into a pustule of central coagulation necrosis surrounded by vesicles within one to seven days after exposure. The lesion further develops into a black eschar with surrounding edema. Bacteremia and lymphatic spread via liver, spleen, and kidneys also may occur;

Pulmonary or inhalational anthrax occurs within one to three days after anthrax spore inhalation. Macrophage ingestion in the alveoli results in hemorrhagic mediastinitis and pulmonary edema, with hemorrhagic pleural effusions. Initially, victims often have non-specific symptoms (cough, fever, and fatigue) and substernal discomfort. They may experience a temporary period of improvement

followed by catastrophic deterioration with severe chest pain. Thoracic imaging demonstrates a widened mediastinum and, in some instances, pleural effusion.

Intestinal anthrax occurs as a result of ingestion of anthrax-contaminated meat or dairy products. Victims develop nausea, vomiting, and fever within 1–7 days of ingestion. Acute abdominal pain with rebound tenderness and ascites also may occur.

Botulism is caused by the neurotoxins in *Clostridium botulinum*, gram-positive, spore-forming anaerobes. It can manifest in several ways.

Food-borne botulism occurs through the ingestion of pre-formed toxin (usually in canned or preserved foods).

Wound botulism is a wound infection that occurs following trauma or surgery, subcutaneous heroin injection, or cocaine snorting, in which toxin from wound colonies spreads systemically.

Intestinal botulism occurs through ingestion of the bacteria found in dirt and dust. It can occur in infants whose immature digestive systems make them especially vulnerable, and in older children and adults who have had bowel surgery or who have intestinal conditions, such as colitis.

Inhalational botulism does not occur naturally, but has potential as a bioterrorist agent when the toxin is aerosolized. To date, inhalational botulism has occurred only accidentally in three veterinary laboratory workers in 1969.⁵

All forms of botulism exposure cause symptoms within six hours to two weeks of exposure, initially affecting the cranial nerves (causing blurred vision, drooping eyelids, and difficulty swallowing) with development of progressive, symmetric, descending motor weakness and a descending flaccid paralysis. Sensation and level of consciousness remain intact.

Plague (*Yersinia pestis*) is a facultative, anaerobic, intracellular, gram-negative bacillus. Generally, it is transmitted via a vector (flea) bite, but aerosolization causing an inhalation infection is possible. Plague takes three forms.

Bubonic plague occurs following skin deposition from a plague-infected vector causing lymphoid invasion and vascular seeding with septicaemia.

Pneumonic plague occurs following direct inhalation of the bacillus and causes multilobar bronchopneumonia with septicaemia.

Primary septicaemia occurs following direct deposition of the bacillus into the vascular system resulting in sepsis without buboes.

All forms of the plague tend to present similarly after one to six days of the bacillus incubation period, with general malaise and pyrexia, abdominal pain, vomiting, constipation, and diarrhea (particularly in the septicaemia form), cough, and shortness of breath. If present, buboes generally are inguinal, axillary, cervical, or epitrochlear. Disseminated intravascular coagulation can result in purpuric lesions, ecchymoses, and digital necrosis, as well as haematemesis, haemoptysis, and melena.

Smallpox (*variola*) is an orthopox virus that is transmitted from person to person. It invades the respiratory epithelial cells, replicates, then spreads hematogenously (after 72–96 hours) to the skin, lungs, kidneys, gastrointestinal tract, and brain, with associated pyrexia, myalgias, headache, and delirium.

The incubation period lasts seven to 17 days, during which time victims are not contagious. In classic variola major, skin invasion causes a maculopapular rash that becomes pustular, initially in the oral mucosa and, then, spreading to the forearms, hands, lower limbs, and trunk. In turn, these pustules progress through macule, papule, vesicle, and umbilicated papule stages before forming a crust and scab. All lesions on the victim's body develop at the same stage of progression. The cutaneous scabs usually fall off 3 weeks after development of the rash; and the patient remains contagious until all scabs have fallen off.

Other presentations of the virus may include: (1) hemorrhagic smallpox, which is characterised by hemorrhagic macules and is rapidly fatal; (2) flat smallpox, with velvety skin lesions and an associated 95–100% mortality rate; and (3) alastrim smallpox (*variola minor*) with lesions that appear similar to variola major but are fewer in number and less florid in appearance.

Tularemia (*Francisella tularensis*) is an aerobic, gram-negative, pleomorphic bacillus carried predominantly by ticks, deer flies, horse flies, rabbits and, increasingly, by domestic cats. It can occur in six forms:

Ulceroglandular tularemia occurs following entry through the skin (usually via a tick or insect bite). The development of a papule occurs on the hands or fingers, after three to five days of incubation, and is associated with painful lymphadenopathy, ulceration and pyrexia.

Glandular tularemia occurs in the same manner as ulceroglandular and presents similarly with regional lymphadenitis, but with no primary skin lesions.

Oculoglandular tularemia occurs after conjunctival inoculation and presents with purulent conjunctivitis and ipsilateral lymphadenopathy.

Oropharyngeal tularemia is rare and follows ingestion of bacillus-infected animal meat or contaminated food and water, and presents with gastrointestinal symptoms and a sore throat.

Pneumonic tularemia follows inhalation exposure to the aerosolized bacillus. It presents with cough, dyspnea, and chest pain, with multilobular infiltrates or pneumonia that may progress to acute respiratory distress syndrome and respiratory failure.

Typhoidal (septicemic) tularemia is a typhoid-like condition that follows bacteremia with symptoms of pyrexia, myalgia, and malaise.

Viral hemorrhagic fevers (VHF) are a group of illnesses caused by arenaviridae (e.g., Lassa fever, which is spread by rodents), bunyaviridae (e.g., Hantavirus, spread by rodents and Crimean-Congo fever, spread by ticks), filoviridae (e.g., Marburg and Ebola), and flaviviridae (Yellow fever and dengue, which are spread by the mosquito).

VHE can be spread through direct contact with an infected person or through contact with their body fluids. Initial signs and symptoms include fever and weakness. Symptoms of increased vascular permeability develop, including hemorrhage, shock, coma, and multi-organ failure.

Ricin is a biotoxin produced naturally by the castor plant (*Ricinus communis*) that inhibits intracellular protein synthesis. Exposure can occur via four routes:

Dermal exposure, which presents a low risk as transdermal absorption is insignificant.

Gastrointestinal exposure occurs with exposure to large amounts of ricin, as its absorption is poor. Gastroenteritis and gastrointestinal hemorrhage may occur.

Parenteral exposure often is rapidly fatal, with severe gastroenteritis and pyrexia.

Aerosol or inhalational exposure often causes fever, cough, and pulmonary edema within a few hours, and can progress to severe respiratory distress and death in 36–72 hours of exposure. Other potential symptoms include cyanosis, diaphoresis, weakness, and bronchoconstriction.

All routes of ricin exposure may produce vomiting, diarrhea, dehydration, hypovolemia, and shock.

BIOLOGICAL EVENTS

Characteristics

Exposure to biological agents may occur through inhalation, oral, or dermal routes. An aerosolized delivery allows the greatest dispersal of the agent, which could make it a terrorist's route of choice. Contamination of food and/or water supplies also is a feasible method of delivery that carries a high rate of dispersal.⁶ Prime agents for terrorism would be those with high infectivity rates and a prolonged period of effectiveness, such as anthrax, plague, and smallpox.

Because of the delayed onset of symptoms, victims, healthcare staff, and government authorities initially may be unaware that a bioagent exposure has occurred. Unless there was an announcement by a terrorist group at the time of the event, it is unlikely that victims would know immediately that they had been exposed, and they would not begin to seek care until they became symptomatic within the ensuing days or weeks. Because of the generalized nature of the symptoms produced by these agents, an accurate diagnosis may not be made of the initial victims seeking care, thereby causing further delays in recognizing the occurrence of a bioterrorist event.

As the number of symptomatic victims increases, so will the demands placed on the healthcare system. For instance, during the peak of the Severe Acute Respiratory Syndrome (SARS) epidemic in Taiwan, 15 to 25 patients with SARS were admitted each day over a four-week period.⁷ In addition to the impact on

available hospital beds and equipment, (such as ventilators, masks, and gowns), biological events impact the staff, some of whom may become symptomatic and unable to work, and some of whom may elect not to come to work.

Once a biological event has been recognized, large numbers of people who have not been exposed but may be concerned for their health also may present to the healthcare facility with symptoms (e.g., sweating and tachycardia) similar to those of infected patients. These patients often are referred to as the “worried well”. These patients need comfort measures rather than medical treatment. Differentiating the “worried well” individuals from the truly infected individuals is difficult and likely to require the capacity for mass physiological screening with a rapid turnaround of diagnostic testing results in order to provide reassurance and epidemiological monitoring. Some biological incidents have resulted in the presentation of hundreds of patients with a psychogenic phenomenon, sometimes referred to as “gas mania”, a name that originated in the trenches of the First World War.⁸

Detection

The occurrence of bioterrorism may be detected by an astute clinician in a sentinel case, by unexplained changes in admission patterns to a hospital or critical care unit, or by formal syndromic surveillance.⁹ However, in order for a sentinel case to be diagnosed, healthcare providers must have adequate background knowledge of potential bioterrorist agents and a high index of suspicion. The routine triaging of patients should include gathering information on recent travel, domestic situation and place of habitation, work patterns, attendance at special events (such as sports events or other mass gatherings), and contact with domestic or wild animals.¹⁰ These routine questions may be modified and/or added to, based on the knowledge of a current event (e.g., questions regarding travel to Hong Kong or Toronto, Canada, during the SARS outbreak).

There are a number of signals or triggers that should prompt consideration of a bioterrorism event. These include the occurrence of:

1. A rapid rise and fall in the occurrence of a particular disease/syndrome (the epidemic curve);
2. A steady increase in the number of cases presenting with a particular disease/syndrome;
3. A disproportionate number of patients with similar symptoms;
4. A disproportionate number of patients from the same locality or venue;
5. A large number of rapidly fatal cases;
6. A disproportionate occurrence of illness in patients who were outdoors as compared with those who were indoors;
7. The presentation of patients with symptoms of an uncommon

- disease (e.g., anthrax or plague); and
8. An associated widespread increase in the number of animal deaths.⁶

As laboratory investigation and confirmation likely will be required for many biological agents, acute care facilities should have standing arrangements with appropriate laboratories to provide this service on a 24-hour basis. In the United States, the CDC, through the establishment of the Laboratory Response Network (LRN), has increased the number of Biosafety Level 3 (BSL-3) state laboratories capable of rapid testing for biological threat agents. In the United Kingdom, the national response framework is structured around Health Protection Agency laboratories. As samples sent to these laboratories may need to be collected and processed in a specific manner, stocks of necessary products (e.g., transport media and personal protective equipment [PPE]) should be available readily to staff responsible for and familiar with their use.¹⁰

Healthcare facilities should participate in local, regional, and/or national syndromic surveillance networks, which can facilitate early identification of an epidemic curve and, in turn, can provide an information cascade to raise staff awareness of particular syndromes in a “just-in-time” manner.¹¹ Staff familiarity with the use and purpose of these surveillance networks should be reinforced on a regular basis in order to ensure efficient information flow during times of crisis.

HEALTHCARE FACILITY PREPAREDNESS

Procedures and Policies

During a biological event, the staffing patterns of a healthcare facility must be adjusted to accommodate the increasing number of patients presenting to the facility, as well as the number of staff members who elect not to or are unable to report to work. Studies have demonstrated that the number of staff who report to work during such an event can be anticipated to be between 50–70% of the regular staff level.¹² Some solutions to the increased staffing needs include extending shifts, housing staff at the facility, providing on-site child and pet care, and increasing the patient/nurse ratio. However, these procedures must be determined and communicated before the event to ensure that the staff is aware of the policies and to ensure that there are no gaps in the provision of staffing during the event.

Each institution must establish plans for two-way information exchange with local public health authorities. These reporting systems for actual or suspected bioterrorist events and other infectious diseases should be available readily to all appropriate staff on a 24-hour basis. Equally important is the reliable dissemination of information from pre-arranged central distribution points to all healthcare facilities; this was a weak point in the response to anthrax-laden let-

ters in 2001.¹² In the United States, the CDC's Health Alert Network (HAN) is one such point of distribution; it provides immediate dissemination of information related to health threats to local and national health officials. However, one study found that only 54% of US hospitals surveyed had an established link to HAN, and that only 40% had 24-hour access to a contact within their local health department.¹³ In the United Kingdom, information is cascaded through the Health Protection Agency and local Primary Care Trust; reporting systems for actual or potential bioterrorist events occurs through a local lead Primary Care Trust via a regional Strategic Health Authority to the central government. Additionally, when a number of healthcare facilities are involved in a bioagent response, real-time cross-facility reporting of patient load and resource availability becomes essential.¹⁴ This may represent a significant cultural shift among hospitals that normally are in competition with each other. Therefore, such cooperative links must be established before any event occurs.

Policy-makers at acute care institutions must recognize that a biological event could overwhelm their resources and, in all likelihood, those of the neighboring facilities. Although the concept of triage is likely to be less alien to staff in the ED than elsewhere in the organization, the shift in healthcare focus to "the greatest good for the greatest number" may be uncomfortable for some, and decisions about the criteria for offering only palliative care to unsalvageable patients should be made in advance and supported by written institutional policy.¹⁵ Some authorities have proposed alternative triage systems for mass-casualty biological events, in which evidence of a toxic syndrome in an ambulatory, or non-ambulatory but alert, patient upgrades their triage category and the antidote is administered quickly, if available, for that particular agent.¹⁶ If such a triage system is to be used, the criteria and process used to guide decision-making must be clarified in advance to protect and support the staff tasked with making those decisions.

Preparedness plans also should include the provision of care for the staff; that is, there should be plans in place for the acquisition and distribution of vaccines or antibiotics, prophylactically, to staff and, if necessary, their families.¹⁷ Support staff from health departments or public health who are not involved in providing acute patient care should be tasked with undertaking this activity during a biological event.

Equipment

Healthcare facilities either must have their own equipment stockpiles or have rapid access to community stockpiles of the equipment required to respond to a biological event. This must include sufficient stockpiles of items to protect staff and prevent the spread of disease, as well as those additional items needed to provide patient care.

PPE for staff who may be exposed to toxins or infectious agents is essential. When the known or suspected infectious agent is transmitted by airborne droplet nuclei (e.g., smallpox or plague), the victim should be placed in a negative pressure room with High Efficiency Particulate Air (HEPA) filtration, if possible, and care providers should wear, at the least, an N95 respirator (in Europe this correlates roughly to an FFP2 or FFP3 mask).¹⁸ Staff require pre-event training and practice, both in donning of the PPE and in providing care while wearing it. Based on the length and magnitude of the event, the supply of the appropriate protective masks may become depleted, even with support from government stockpiles. This occurred in Hong Kong during the SARS epidemic.¹⁹ The US Occupational Safety and Health Administration (OSHA) advises that the reuse of N95 masks may be considered if supplies are depleted and the masks are not obviously soiled.²⁰

Recommendations for the quantities of masks and other PPE that must be stockpiled by hospitals and the community vary. National or federal stockpiles of equipment and consumables (in the form of “push packages” in the United States,⁹ and “pods” in the United Kingdom) may be made available to health-care facilities within hours to days. Institutional preparedness plans must take into account local variation in stockpile availability and the estimated time for delivery. Unfortunately, generic stockpiles may not be well-suited to an incident that disproportionately affects a particular special population, such as the elderly or children.²¹

During certain biological events, medical equipment, such as ventilators, may be in short supply. Within the US hospital system, there are a total of 105,000 ventilators, while estimated ventilator requirements during a flu pandemic are projected to be approximately 742,500.¹² The US Strategic National Stockpile contains approximately 5,000 ventilators, well below the projected needs in a widespread biological event. Pre-arranged agreements between hospitals and area vendors may help supplement the number of ventilators available. The utilization of older ventilators or the conversion of anesthesia machines for ventilator use also may supplement the supply. With a probable shortage of ventilators during a large-scale event, healthcare leadership must consider the potential development of a ventilator triage process that would guide medical staff in determining which patients are provided with a ventilator and which are not. Application of the Sequential Organ Failure Assessment Score (Appendix 12B) provides an option for ethically defensible triage.²²

Alternate Treatment Sites

Alternate treatment sites have been identified as a means of providing surge capacity for mass-casualty incidents. In a biological event, these sites would

be set up as direct patient care sites as well as a means for increasing available isolation bed space.

An alternate treatment site may be set up at a pre-established location and can utilize an existing building, tent, or mobile structure. It can be operated with staff support and supplies from public health departments, area hospitals, and local emergency management agencies through pre-established agreements.

The US Department of Health and Human Services recommends that potential alternative care sites be assessed for their ability to provide the following:²³

1. Increased bed capacity and separation of patients;
2. Hygiene and shower facilities;
3. Food services;
4. Sufficient capacity for storage of PPE, supplies, and linen; and
5. Safety and security.

Hospitals also must identify areas within their own buildings that can be converted into patient care areas. These alternate care areas address the surge of increasing admissions by providing additional spaces within the facility to care for the patients. Establishing alternate care areas may involve converting the function of a well-supplied area, such as a surgical recovery area, to a receiving area for admitted patients; or it may involve transforming a non-patient care area, such as a cafeteria or waiting room, into an area being used for patient care. Plans must not only identify space, but also detail the procedures for obtaining needed supplies and staff.

Ideally, patients with infectious diseases transmitted via the airborne route should be placed in a private, negatively-pressurized room with HEPA filtration, which removes almost all of the airborne particles. Medical-use HEPA filtration also incorporates high-energy ultraviolet light to kill any live bacteria or viruses collected by the filter. However, most healthcare facilities have a limited number of negative-pressure rooms sufficient for the needs of a bioterrorism event. On the assumption that all of the victims of a particular biological event have been exposed to the same agent, it would be reasonable for facilities to plan for the placement of these patients in shared rooms, i.e., cohorts, ideally with a ventilation supply that is separate from the non-infected areas of the hospital.²⁴

Large-scale biological incidents may require that infected patients be grouped together on entire floors/wards or, in extreme circumstances, entire wings or buildings of the institution. To limit the number of staff working in these isolation areas, it may be advisable for staff to work alternating 12-hour shifts and to be housed at the hospital. Seeking volunteers for this assignment, offering bonuses, or seeking those who have had the necessary vaccination (based on the agent) are some methods that may be useful in providing staff in these areas.

Screening Centers

Screening centers, or “fever clinics”, as were established in both Hong Kong and

Toronto during the SARS outbreak, can serve as externally located triage facilities. Such centers may be located immediately outside of the hospital or located elsewhere in the community through coordination by public health departments. These centers can help to reduce overcrowding in the EDs and, by virtue of the increased space, may decrease the risk of transmission during patient assessments by providing sufficient space between each patient. When some hospitals in Toronto were closed by the Public Health Department because of the spread of SARS, establishing screening centers outside of the hospital increased the ability of the hospital to continue functioning throughout the event.²⁵

The establishment of screening centers requires a well-planned strategy for providing consistent information from public health officials for those patients sent home from the center. This is essential to promote compliance with any required home care or home quarantine, and, in turn, for ensuring needed patient information is properly documented and forwarded to Public Health services.

ANTHRAX PROPHYLAXIS CLINIC

In late October 2001, four postal workers from a mail processing center in Washington, DC were hospitalized from inhalational anthrax; two ultimately died. The US Public Health Service (USPHS) established a temporary anthrax prophylaxis clinic at DC General Hospital to receive other potentially exposed persons from the postal centers. The clinic operated 14 hours/day for a period of 14 days, and over that time dispensed medication to 18,051 persons. Individual patient processing time varied from 20 to 55 minutes. Patients initially completed a questionnaire and then, in groups of 50, listened to a presentation on anthrax by a physician and a pharmacist. This was followed by a question-and-answer period. All patients received a 10-day supply of appropriate antimicrobial medications. This allowed sufficient time to test all potentially exposed postal center employees and to determine who would need the full 60-day treatment regimen.⁴⁶

Robert Powers

HEALTHCARE FACILITY RESPONSE

Implementation

Implementation of a healthcare facility's response plan begins either with recognition by trained staff members of potentially exposed, arriving victims, or through notification from a public health entity. Staff should be trained in the use of, and have immediate access to, the necessary PPE. Suspected victims should be masked and removed immediately from the waiting room to an isolation room with negative pressure capability. As learned in Toronto during the SARS epidemic, victims quickly can spread airborne diseases in crowded waiting rooms or EDs.²⁶ Unless immediate triage can be performed, screening

of potentially infected victims outside of the hospital building, or the masking of all patients until triage is performed, may be appropriate containment strategies. Given the likely problems with supplies of masks, the former method is preferable.

The overall hospital response to a bioterrorism incident should mirror the institution's response to a non-biological MCI as closely as possible. The hospital should implement its incident command structure (e.g., Hospital Incident Command System²⁷ or the UK Medallion System, which utilizes Gold, Silver and Bronze levels to correspond to strategical, tactical, and operational command)²⁸ to: (1) coordinate the response and communications with other agencies; (2) expand facilities and staffing; (3) manage multiple patients; (4) care for the patients' relatives; and (5) provide robust media management. Regulated and reliable information flow to the media may reduce the likelihood of covert media activity with its attendant risk of infection spread.²⁹

Hospital lockdown, i.e., securing all portals of entry, may be necessary to prevent the contamination of inpatient areas.¹⁷ Incoming patients should be routed around the hospital to the identified, appropriate entry point (e.g., the designated ED entrance or the screening center). This requires allocating security staff to enforce these closures and erecting clear signage to redirect patients and visitors to the appropriate entrance.

It is likely that the care and management of patients with specific biological syndromes will be provided by healthcare professionals who are inexperienced with such diseases. Of US anesthesiology resident programs surveyed, only 37% included training in the management of the effects of chemical and biological weaponry.³⁰ Therefore, healthcare facilities must ensure that easy and reliable access to biological information is available readily for up-to-date guidelines regarding patient management. In a large-scale event, this information may be provided to the hospital through systems such as the CDC's HAN in the United States, and the Health Protection Agency in the United Kingdom. Public health Websites also provide regularly updated treatment information about specific biological agents. Hospital infection control staff also should ensure that there are easily-accessed hard copies of the latest biological agent information on hand in case of complications with the computer system during an event. Additionally, the hospital should ensure distribution of information to all staff during the event, detailing the measures they need to take for personal protection (e.g., N95 mask usage).

Decontamination

Decontamination procedures for a biological event likely will not be necessary. As most patients do not proceed to the hospital until they become symptomatic, (i.e., days to weeks after their exposure), they will have self-decontaminated at home by

showering and changing clothes multiple times within that time period.

A notable exception would be a terrorist event that was announced to the media as it was happening or shortly thereafter. When victims become aware of the event through such an announcement, they likely will proceed to the nearest hospital for care, and likely will not have had sufficient time to self-decontaminate at home. These individuals will require outside decontamination prior to entry into the healthcare facility.

However, because not all biological agents are transmitted through direct contact, only exposure to those agents (plague, viral hemorrhagic fevers, or ricin toxin) that spread through direct contact would require that victims undergo decontamination procedures beyond removal of contaminated clothing.

Sustainability

Sustaining healthcare facility operations is likely one of the most important challenges during a bioterrorism response. Unlike conventional terrorist activity (for example the London bombings in July 2005, when EDs resumed normal functionality within six to eight hours),³¹ presentations of victims of bioterrorist events may occur over ensuing days or even weeks, and the care and management of infected patients is likely to extend for several weeks.

Unless an attack is geographically limited, affected healthcare facilities are unlikely to be able to utilize mutual aid agreements to transfer patients to other facilities for care as all hospital facilities will be overwhelmed.³² Additionally, to limit contamination, hospitals may be prevented from transferring exposed patients. This occurred in Toronto when public health officials prevented Toronto hospitals from transferring SARS-infected patients to other hospitals. Thus, hospitals must plan on providing care for patients through the utilization of stockpiles, alternate care sites within the hospital, and altered staffing patterns.

A widespread biological attack with a prolonged effect may impair the economic infrastructure of the community to the point that a facility's supply chain is compromised and no longer functional.⁶ Thus, in addition to having sufficient stockpiles of PPE and treatment agents, (e.g., ciprofloxacin), hospitals need these supplies to be close at hand so that they can be obtained readily without undue dependency on transportation or other, potentially incapacitated, support services.

Implementing revised admission criteria and cancelling all elective surgeries are strategies used to free bed space. These steps also allow the utilization of post-anesthesia care areas for alternative care sites. Supplies required for the conversion of non-treatment areas of the hospital into treatment areas should be identified before the event. Consideration should be given to the ability to gather supplies quickly and detailed plans should include identification of the key contact person and the criteria that will be used to provide the "green light" for the readiness of the area to accept patients.

Hospitals also may need to handle a larger-than-usual number of fatalities as a result of the disease process and the disruption of normal funeral practices; contingency arrangements must be in place for the management of large numbers of potentially infectious bodies.¹⁷ Management options include coordinating efforts with specialized response units, such as the US Disaster Mortuary Operational Response Team (DMORT), or acquiring refrigerated trucks from the local community for storing bodies.

In addition to changing standard staffing patterns, identified non-essential staff members may be reassigned to essential roles. Staff confidence and willingness to come to work also must be considered. Studies of hypothetical SARS and smallpox outbreaks have identified that although 63% of hospital staff indicate they would be willing to report to work during a SARS epidemic, only 48% indicated they would be willing to attend to patients.³³ Additionally, in the absence of a vaccine and PPE, only 4% of surveyed paramedics indicated that they would report to work during a smallpox outbreak. The provision of PPE alone would improve this response to only 37%.³⁴ In a recent study, Canadian nurses reported that they were inadequately equipped and trained to work during an infectious outbreak, particularly one resulting from an act of terrorism.³⁵ Providing adequate stockpiles of PPE and increasing staff confidence through training and exercise in the use of PPE would increase the willingness of staff to provide care for patients of a biological event. Indeed, 74% of nursing students identified personal protection as their primary concern in the event of a disaster.³⁶ Other studies of healthcare providers have found low levels of necessary knowledge and confidence to respond to bioterrorism events.^{37–39}

The stress and associated dangers experienced by staff caring for the victims may necessitate psychological support for the staff. Hospital planning must include the care and counselling needs of staff; each shift should begin and end with opportunities for the staff to debrief with co-workers. This should be supplemented by available psychiatric crisis management that may be required for patients and the extended demand for bereavement counselling that is likely to accompany mass fatalities.^{8,14}

In the event that the demand for resources (particularly those involving critical care) exceeds the supply, providing the usual practice of care may not be sustainable. Staff duty patterns may need to be amended (e.g., a 12-hour, rather than an eight-hour shift) for a limited period of time. Alternatively, non-specialist staff may be deployed to specialist areas to work under the supervision of fewer specialist staff, as recommended by the Society of Critical Care Medicine.³² At some point, it may become necessary to triage patients to ensure that resources are directed towards those most likely to benefit, even to the detriment of patients who under normal circumstances would receive all care

and treatments. A number of systems have been suggested to optimise this process,^{40,41} and the ethical issues surrounding such a situation have been discussed, particularly in the context of pandemic influenza planning.^{42,43} However, no agreement has been reached regarding which system should be used and no system has been demonstrated to be effective or usable in conditions such as those induced by a bioterrorist attack. These issues are complex and potentially contentious, and should be addressed before any event by all facilities and their ethics committees, preferably in conjunction with their local communities.

CONCLUSION

Terrorist attacks using biological agents can strain a hospital's ability to continue providing medical care throughout the duration of the event. Trained staff and easily-implemented plans based on clearly defined criteria can protect the hospital by providing the ability to rapidly identify potentially exposed victims and taking steps to prevent the further spread of the biological agent. Clear procedures for expanding into alternative care sites or for opening screening centers can facilitate the hospital's response to an event. Stockpiles of PPE and medications, along with the means for obtaining additional critical care services, assure that the hospital can sustain and extend its functional duration.

IN LATE 2002, THE UNITED STATES began the first phase of a smallpox vaccination program to increase preparedness in the event of a smallpox attack. The plan called for one-half million military personnel to be vaccinated along with an additional approximately one-half million healthcare first responders, i.e., front-line workers in emergency medical services, hospital EDs, and public health agencies. During 2003, smallpox vaccinations were administered to 39,213 healthcare workers who volunteered to receive the vaccine. Due to concerns about the expense of the program versus its priority, and concerns over adverse reactions, the program ended without progressing to the planned second stage, which would have vaccinated millions of other healthcare workers and the general public.⁴⁷ By the end of 2003, there had been 97 reported serious complications, including myocardial infarction, cardiomyopathy, seizures, Parkinson's disease, and appendicitis, as well as three deaths following the smallpox vaccination.⁴⁸

Robert Powers

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Appendix 12A: Bioterrorism agents^{44, 45} (IV = intravenous; CT = computerized tomography; ELISA = enzyme-linked immunosorbent assay; IM = intramuscular; PCR = polymerase chain reaction; CDC = Centers for Disease Control and Prevention)

CATEGORY A AGENTS					
	Incubation	Presentation	Investigations	Management	PPE/Prophylaxis
Anthrax — cutaneous	Immediate – 1 day	Papular lesion that becomes vesicular Black eschar in 7–10 days	Culture	Ciprofloxacin or doxycycline for 60 days	Standard precautions Avoid contact with wound
Anthrax — inhalational	Usually <1 week, up to 2 months	Initially non-specific malaise; high fever and severe respiratory distress 1–5 days later	Chest X-ray: mediastinal widening, pleural effusion; Culture blood, pleural fluid, CSF	Ciprofloxacin or doxycycline IV, continued orally for 60 days	Standard precautions
Anthrax — gastrointestinal	1–7 days	Nausea, vomiting, bloody diarrhea, acute abdomen; Ascites and shock 2–4 days later	Abdominal CT: mesenteric adenopathy Chest X-ray: mediastinal widening, pleural effusion Culture blood, ascitic fluid	Ciprofloxacin or doxycycline IV, continued orally for 60 days	Standard precautions
Anthrax — oropharyngeal	1–7 days	Pyrexia, throat pain, regional lymphadenopathy, tongue base ulcers	Blood and throat cultures	Ciprofloxacin or doxycycline IV, continued orally for 60 days	Standard precautions
Arenaviruses (Lassa, Junin, Machupo, Guanarito, Sabia)	5–6 days	Pyrexia, malaise, bleeding, adenopathy, conjunctivitis	Serum ELISA, viral culture	Supportive care, some role for ribavirin	
Botulism	6 hours – 10 days, usually 12–36 hours	Cranial neuropathies, symmetrical descending paralysis	Demonstration of toxin in stool or serum; Culture blood, stool	Antitoxin, supportive care	Standard precautions
Ebola/Marburg virus	2–9 days	Pyrexia, malaise, icterus, bleeding	Serum ELISA	Serum ELISA	
Plague	1–6 days	Pyrexia, weakness, pneumonia	Blood, tracheal washing culture	Streptomycin IM or gentamicin IV	Droplet precautions Ciprofloxacin or doxycycline post-exposure prophylaxis
Smallpox	7–17 days	2–4 day prodrome of pyrexia and malaise; 4 days of vesicular rash with central indentation; 15 days of pustular rash and scabbing	PCR (regulated by CDC in US)	Supportive	Airborne precautions Vaccination available (up to 7 days post-exposure)

Appendix 12A: Continued

CATEGORY A AGENTS					
	Incubation	Presentation	Investigations	Management	PPE/Prophylaxis
Tularemia	3–5 days (up to 14 days)	General malaise, cough, diarrhea, pneumonia	Culture sputum, stool	Streptomycin IM or gentamicin IV Ciprofloxacin or doxycycline orally for mass casualties	Standard precautions Ciprofloxacin or doxycycline post- exposure prophylaxis
CATEGORY B AGENTS					
	Incubation	Presentation	Investigations	Management	PPE/Prophylaxis
Brucellosis	2–4 weeks	Non-specific malaise, meningitis, endocarditis	Isolation in clinical specimen or rising titres	Doxycycline plus rifampicin	Standard precautions Doxycycline plus rifampicin post-exposure prophylaxis
Cholera	<1–5 days	Profuse watery diarrhea (can be mild or asymptomatic)		Oral rehydration	
Clostridium perfringens Epsilon toxin	Unknown	Non-cardiogenic pulmonary edema		Supportive care	Unknown
Crypto- sporidium parvum					
Escherichia coli 0157	2–8 days	Bloody diarrhea, abdominal pain, hemolytic uremic syndrome	Culture stool	Avoid antibiotics and anti- diarrheals; supportive care	Standard precautions
Glanders	1–5 days	Acute localised infection, septicemia, acute pulmonary infection, chronic cutan- eous infection	Culture blood, sputum, urine, skin	Sulphonamides, doxycycline, ciprofloxacin	Droplet precautions Possible trimetho- prim-sulfametho- xazole prophylaxis
Melioidosis	2 days–years	Acute localised infection, pulmonary infection, septicemia, chronic suppurative infection	Culture blood, sputum, urine, Skin culture Antibody titres	Augmentin, tetracycline, trimethoprim- sulfamethoxazole	
Psittacosis					
Q fever	2–3 weeks (may be shorter with large exposure)	Pyrexia, gen- eral malaise, pneumonia, hepatitis, endocarditis	Antibody detection	Doxycycline orally for 15–21 days Quinolones	Standard precautions Doxycycline or tetracycline post-exposure prophylaxis

Appendix 12A: Continued

CATEGORY B AGENTS					
	Incubation	Presentation	Investigations	Management	PPE/Prophylaxis
Ricin toxin	< 8 hours (inhalation) < 6 hours (ingestion)	Respiratory distress, vomiting, bloody diarrhea, renal failure, hallucinations	No specific testing available	Early decontamination Supportive care	Standard precautions once patient is decontaminated
Salmonellosis	12–72 hours	Diarrhea, abdominal pain, pyrexia, septicemia	Culture stool	Supportive care Ampicillin, gentamicin, trimethoprim, ciprofloxacin in septicemia	Standard precautions
Shigella	1–2 days	Diarrhea, abdominal pain, pyrexia	Culture stool		Standard precautions
Staphylococcal enterotoxin B	1–4 hours	Nausea, vomiting, abdominal pain, respiratory distress (inhalational exposure)	Serum and urine toxin detection	Supportive care	Standard precautions
Typhoid		Pyrexia, abdominal pain, pain, rose-coloured spots	Culture stool and blood	Ampicillin, trimethoprim-sulfamethoxazole, ciprofloxacin	
Typhus					
Viral encephalitis		Pyrexia, malaise, headache	Culture spinal fluid or PCR	Supportive care	Standard precautions
CATEGORY C AGENTS					
	Incubation	Presentation	Investigations	Management	PPE/Prophylaxis
Hantavirus		Prodrome, non-cardiogenic pulmonary edema or oliguric renal failure	PCR	Ribavirin	Standard precautions
Nipah virus	2 weeks	Pyrexia, headache, vomiting, hyporeflexia	Culture spinal fluid, urine, tracheal aspirate	Supportive care	Standard precautions

Appendix 12B: The Ontario System for triage to the critical care unit²² (S_aO_2 = oxygen saturation of arterial blood; FiO_2 = fractional inspired oxygen; SBP = systolic blood pressure; TBSA = total burn surface area; NYHA = New York Heart Association; COPD = chronic obstructive pulmonary disease; FEV_1 = forced expiratory volume in 1 second; PaO_2 = partial pressure of arterial oxygen; VC = vital capacity; TLC = total lung capacity; RAP = right atrial pressure; PAP = pulmonary artery pressure; SOFA = sequential organ failure assessment)

INCLUSION

The Presence of Either of the Following Two Conditions:

1. Requirement for invasive ventilatory support:
 - a. Refractory hypoxemia ($SaO_2 < 90\%$ on non-rebreathe mask/ $FiO_2 > 85\%$);
 - b. Respiratory acidosis ($pH < 7.2$);
 - c. Clinical evidence of impending respiratory failure; or
 - d. Inability to protect/maintain airway
2. Hypotension (SBP < 90 mmHg, or relative) with evidence of shock (altered consciousness, decreased urine output, other end-organ failure) unresponsive to fluids and requiring inotropic or vasopressor support.

EXCLUSION

The Presence of Any of the Following Conditions:

1. Severe trauma;
2. Severe burns with either age > 60 years, or $> 40\%$ TBSA, or inhalation injury;
3. Cardiac arrest, either unwitnessed, or unresponsive to defibrillation/pacing, or recurrent;
4. Severe baseline cognitive impairment;
5. Advanced untreatable neuromuscular disease;
6. Metastatic malignant disease;
7. Advanced and irreversible immunocompromised condition;
8. Severe and irreversible neurological event or condition;
9. End-stage organ failure:
 - a. NYHA class III/IV heart failure;
 - b. COPD with $FEV_1 < 25\%$, baseline $PaO_2 < 55$ mmHg, or pulmonary hypertension;
 - c. Cystic fibrosis with post-bronchodilator $FEV_1 < 30\%$, or baseline $P_aO_2 < 55$ mmHg;
 - d. Pulmonary fibrosis with VC or TLC $< 60\%$, baseline $P_aO_2 < 55$ mmHg, or pulmonary hypertension;
 - e. Primary pulmonary hypertension with NYHA class III/IV heart failure, mean RAP > 10 mmHg, or mean PAP > 50 mmHg; and
 - f. Child-Pugh score ≥ 7 ;
10. Age > 85 years; or
11. Elective palliative surgery.

INITIAL ASSESSMENT		
Triage	Criteria	Action/Priority
Blue	Exclusion criteria met or SOFA > 11	Medical/palliative management Discharge from critical care unit
Red	SOFA ≤ 7 or single-organ failure	Highest priority
Yellow	SOFA 8–11	Intermediate priority
Green	No significant organ failure	Defer/discharge Reassess as needed

48-HOUR ASSESSMENT		
Triage	Criteria	Action/Priority
Blue	Exclusion criteria met, or SOFA >11 or SOFA 8–11 and stable	Palliative care Discharge from critical care unit
Red	SOFA <11 and decreasing	Highest priority
Yellow	SOFA <8 stable	Intermediate priority
Green	No longer ventilator-dependent	Discharge from critical care unit
120-HOUR ASSESSMENT		
Triage	Criteria	Action/Priority
Blue	Exclusion criteria met or SOFA >11 or SOFA <8 stable	Palliative care Discharge from critical care unit
Red	SOFA <11 decreasing progressively	Highest priority
Yellow	SOFA <8 with <3-point decrease in 72 hours	Intermediate priority
Green	No longer ventilator dependent	Discharge from critical care unit



CHAPTER 13

EMERGENCY MANAGEMENT OF RADIATION INJURIES AND ILLNESSES

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OVER THE LAST HALF CENTURY, radioactive materials have come to play an increasingly important role in societal functions. Today, hundreds of large-scale commercial nuclear power plants are in operation in countries around the globe, with dozens more planned or under construction.¹ The uses of radioactive materials extend far beyond the production of electricity. Literally, millions of radioactive sources are in use around the world, in such diverse settings as research and educational laboratories, healthcare, and business. Hospitals, for example, use radioactive materials extensively on a daily basis in applications ranging from diagnostic x-rays to the treatment of cancer. Industry, likewise, uses radioactive sources in a multitude of ways. In short, radioactive materials have become an integral part of modern life.^{2,3}

OBJECTIVES:

- Understand the scientific and medical bases for nursing management of ionizing radiation-induced injuries and illnesses;
- Describe radiation protection and contamination control while handling injured/ill victims who are contaminated with radioactive materials;
- Identify issues related to radiological and nuclear incidents that may affect the delivery of health care; and
- Describe additional resources available to assist in the management of radiological incident victims

Along with the many benefits associated with the use of radioactive materials, there are the possibilities of misuse or accidents. While technical safeguards, rigorous training, and effective regulation can reduce greatly the likelihood of such incidents, they cannot eliminate the risk entirely. Radiological

incidents occur relatively infrequently, and most are managed easily and cause little or no harm. However, on occasion, incidents can be extremely serious, exposing people to substantial doses of radiation and causing grave injuries, illness, and/or death. Reducing the morbidity and mortality during such an incident requires an informed, well-practiced, and effective healthcare response.

Further underscoring the need for hospitals and healthcare professionals to be fully prepared to manage radiation injuries is the growing concern of the possibility of terrorism involving radioactive materials. This concern stems from a variety of factors, including: (1) the vulnerability and lack of adequate security of many radioactive sources; (2) thefts and acquisition attempts; (3) the global illegal trade in radioactive materials; (4) the wide availability of weapons-making knowledge; and (5) the fact that known terrorist groups openly have stated their desire to use such weapons. These and other factors place the threat of terrorism involving radioactive materials high on the world's security agenda.⁴ This growing concern about the possibility of terrorism involving radioactive materials deems it essential that hospitals and healthcare professionals have well-rehearsed response plans and are well-trained in order to respond rapidly and appropriately to an incident involving radioactive materials.

This chapter provides an overview of the fundamentals of emergency healthcare management of radiation incidents and radiation injuries and illnesses. Included are a variety of additional sources of information and training materials that can be helpful in preparing healthcare staff to manage effectively the consequences of such an incident.

REVIEW OF RADIATION BASICS

According to the Health Physics Society (<http://hps.org/publicinformation>), *radiation* is defined as energy that comes from a source, travels through space, and is able to penetrate various materials. *Ionizing radiation* is emitted when the unstable nucleus of an atom spontaneously decays or breaks down; the energy emitted can be in the form of electromagnetic waves or subatomic particles. Ionizing radiation is of sufficiently high energy to displace or “knock out” electrons from atoms or molecules with which it comes in contact, creating ions or ion pairs. These ions can cause DNA damage, cell injury, and other adverse health effects. Some radiation such as microwaves, ultraviolet light, and radiowaves are non-ionizing. Although non-ionizing radiations can cause some adverse health effects, from a clinical standpoint, it is ionizing radiation that is most deleterious and, therefore, the focus of this chapter.

Depending on the source involved, the following types of radiation may be encountered: (1) alpha particles; (2) beta particles; (3) gamma rays and x-rays; and (4) neutrons.

Types of Radiation

Alpha particles (α) are large in size and can be very damaging to cells that they encounter. However, these particles have very limited penetrating capacity; they cannot penetrate a sheet of paper or the epidermis of skin. The hazards they pose occur when alpha-emitters are internalized by inhalation, ingestion, or through penetrating wounds.

Beta particles (β) are small and have a greater penetrating capacity than do alpha particles. Beta particles can penetrate the unprotected epidermis and cause cutaneous injury. However, shielding against beta particles can be accomplished quite easily with barriers such as a piece of tinfoil, several sheets of paper, or layers of clothing. Beta particles can be a hazard if beta-emitters are internalized by inhalation, ingestion or penetrating wounds.

Gamma (γ) rays and *x-rays* are electromagnetic waves, commonly called photons. They have a wide range of energies, many of which have great penetrating capacity and are able to penetrate the body and reach internal organs. Protection against gamma rays and higher energy x-rays requires the use of lead barriers, thick concrete, or similarly dense materials.

Neutrons (n) are highly energetic particles that originate from atomic nuclei. They have a high penetrating capacity, pose both internal and external hazards, and require the use of thick shielding for protection.⁵⁻⁷ Neutrons are the only radiation that cause the absorber, itself, to become unstable and radioactive. Fortunately, incidents involving neutron radiation are quite rare.

Exposure versus Contamination

The medical management of victims of radiological incidents requires an understanding of the difference between radiation *exposure* and *contamination*. Radiation *exposure*, more accurately referred to as *irradiation*, occurs when all, or part, of the body is exposed to radiation from an unshielded source, as occurs during a diagnostic x-ray. Although the electromagnetic waves enter or pass through the person's skin and body, and have the potential to cause adverse health effects to the person, the exposed person does not become radioactive. Persons who have been exposed or irradiated have no radioactive material on or in them, and, thus, present no radiological threat of harm to others. Radiation exposure may occur acutely (within seconds to minutes) or chronically over a prolonged period of time.

Contamination refers to the deposition of radioactive material in or on a person, or any place in which it is not desired (e.g., the environment). If a

radioactive material is deposited on the skin or clothing of an individual, the person is said to be *externally contaminated*. If a radioactive material is inhaled, swallowed, crosses the skin barrier, or enters the body through a wound, the person is said to be *internally contaminated*. Typically, most external radiation contamination can be eliminated by removing the contaminated individual's clothing and washing the skin. *Internal contamination*, on the other hand, presents a more complex problem. If the level of internal contamination is significant, medications may be required to help eliminate the radioactive materials from the body. Internal contamination with very soluble radioactive materials may result in their excretion in the sweat, saliva, urine, and/or feces of the contaminated individual. These situations require that radiation protection and contamination control be essential parts of healthcare management plans.

Radiation Dose and Units of Measurement

As radiation moves through the body, it disrupts molecules and deposits energy. This energy is referred to as the radiation dose, i.e., the absorption of radiation energy per unit of mass. The *Gray* and the *rad* are the units commonly used to indicate the absorbed dose. An easy way to remember and understand the term *rad* is that it is the acronym for "radiation absorbed dose". One rad is equivalent to 100 ergs of energy/gram. Internationally, only the United States still uses this unit of measurement; the rest of the world uses the *Gray* unit, which is equivalent to 100 rads. Both of these units are used in referring to acute exposures that cause early, obvious adverse health effects.

At low radiation doses, or at doses received chronically over weeks to years, the *Sievert* and *rem* units are used. An easy way to remember and understand the term *rem* is that it is the acronym for "rad equivalent in man". It is the measurement unit for "dose equivalent", which refers to the biological damage or the resulting long-term biological risk from a radiation dose. The *rem* unit of measurement is used only in the United States; the rest of the world uses the *Sievert* unit, which is equivalent to 100 *rem*.

Quality factors for the various kinds of radiation relate to their effectiveness in causing ionizations. For example, alpha particles and neutrons are very efficient at causing ionization and have quality factors of three to 20 times those of gamma and x-rays. Therefore, the long-term risk associated with exposure to alphas and neutrons is much higher than with other types of radiation.

Radiosensitivity

The acute doses of radiation to the whole body that cause adverse effects are highly variable depending upon the radiosensitivity of various cells and tissues in the human body. For example, the lethal dose-50 (LD₅₀), (i.e., that

DOSE	EFFECTS
<10 rads (0.1 Gray)	No detectable difference in exposed versus non-exposed patients
>12 rads (0.12 Gray)	Sperm count decreases to a minimum level by approximately day 45
20 rads (0.2 Gray) whole body	Detectable increase in dicentric chromosome aberrations; No clinical signs or symptoms
75–100 rads (0.75 – 1.0 Gray) whole body	Detectable bone marrow depression Nausea/vomiting in a small percentage of the population 10% of exposed persons experience emesis at 100 rads (1 Gray) percentage increases with increasing dose

Table 13.1: Effects of low and high acute radiation doses¹⁵ (Used by permission)

dose of ionizing radiation that will kill 50% of a population) for untreated acute, whole-body radiation in humans is around 400 rad or 4 Gray. Table 13.1 lists some effects on the human body at various doses of radiation. Note that clinically obvious signs/symptoms do not appear until a radiation dose of close to 100 rad or 1 Gray is reached. The young and the elderly are more susceptible to radiation injuries and illnesses; at the same radiation doses, they may become much sicker than healthy older children, adolescents, and adults <60 years of age.

RADIOLOGICAL AND NUCLEAR INCIDENTS

In planning and preparing for the medical, public health, and community responses to radiological incidents, a number of possible scenarios should be considered.^{8,9} Depending upon the community, some events may be more likely to occur than others.

Exposure Incidents and Radiation Exposure Devices

A *radiation exposure incident* occurs when people are exposed directly to radiation from some external source. Because radioactive material has not been transferred to the individual, there is only exposure and no radioactive contamination. Such an incident could be accidental. There have been a number of cases around the world where people have encountered industrial or medical radiological sources that had been abandoned or “orphaned”. In some of those instances, people had been exposed to significant doses of radiation that have resulted in injury or death.¹⁰

A radiation exposure incident also could occur as a result of a criminal act or terrorism involving a simple *radiation exposure device* (RED). Such a radioactive source could be placed surreptitiously near a target with the express intention of causing harm to unsuspecting victims. Any number of radiation sources used in medicine, industry, and academia could be utilized

since they can be highly radioactive, and often, are poorly protected from loss, theft, or misappropriation. Common radionuclides that could be used for these purposes include Cobalt-60, Cesium-137, and Iridium-192.

Dispersal Incidents and Radiological Dispersal Devices

A *radiation dispersal incident* involves the release of radioactive materials causing the contamination of both people and the environment. A dispersal incident could occur as the result of an accident, such as occurred in Goiânia, Brazil, in 1987, when scavengers opened an abandoned radiotherapy source that contained Cesium-137. Ultimately, this radioactive material was spread over a wide area contaminating the environment and scores of people, four of whom died from internal contamination and severe acute radiation syndrome.¹¹

A dispersal incident also could occur as a result of a criminal or terrorist act. A radiation dispersal device (RDD) includes any method by which radioactive materials could be spread into the environment. The most worrisome type of RDD is a radioactive “dirty bomb” that contains both explosives and radioactive material that would be pulverized or aerosolized, then spread, resulting in environmental and human contamination. The amount and range of the radioactive material spread, and the severity of the impact would depend upon such factors as the type and amount of explosives used, weather conditions, and population density in the affected area. A “dirty bomb” has the potential to cause both internal and external contamination. However, it is the detonation of conventional explosives that likely would be responsible for the most serious, immediate effects of such an incident.¹² The blast could cause imbedded shrapnel, thermal burns, and mechanical trauma to those individuals close to the epicenter of the explosion. Unfortunately, it is unlikely that the nature of the incident and the proximity of the victims to the source will be known with certainty by the time victims arrive at the hospital.

Criticality Incidents

A *criticality incident* is a chain reaction of nuclear fission, which is the splitting of atomic nuclei with the release of a tremendous amount of energy and radioactive materials. A *criticality* refers to a fission process and is not necessarily a detonation; however, a nuclear detonation is a *criticality incident*. Such an incident occurred in Tokaimura, Japan, in 1999, at a uranium processing facility.¹³ Several errors caused this *criticality incident* that resulted in 310,000 people being sheltered-in-place, the evacuation of 161 people living nearby, and the severe injury of three workers, two of whom subsequently died. A number of criticality incidents have occurred in military and research facilities. Victims in the relatively immediate vicinity of a criticality incident usually succumb to severe acute radiation syndrome, multiple organ damage, and death. Medical

management is emergent because victims who are close to a *criticality incident* will be seriously ill.

Nuclear Detonations

Nuclear detonations of sophisticated nuclear weapons or improvised nuclear devices pose both internal and external radiological hazards. Because of technical and other challenges associated with creating a nuclear weapon, it is believed that the occurrence of a nuclear detonation has a low probability. However, should a nuclear detonation take place, the consequences for the affected area and the people living there would be catastrophic. The medical consequences of a nuclear detonation will depend upon the proximity of the victims to the epicenter of the detonation, and could include blast injuries, blunt trauma, thermal burns, and radiation injuries.¹⁴ Emergent care would be required for potentially thousands of victims and almost certainly would overwhelm nearby healthcare facilities that remain functional. Again, it is unlikely that the location of individuals relative to the epicenter of such an incident would be known with any certainty by the time they begin to arrive at the hospitals.

Another hazard resulting from a nuclear detonation involves the spread of fission products into the atmosphere creating an inhalation hazard. The subsequent settling of radioactive materials onto the ground (radiation fallout) then can be taken up by plants or eaten by animals, and, eventually, enter the food-chain, resulting in widespread, internal contamination of humans via ingestion. Later, radioactive materials on the ground can become re-suspended to create yet another inhalation hazard.

NURSING MANAGEMENT OF RADIOLOGICAL INCIDENT VICTIMS

General Considerations

In a way, the nursing management of radiological/nuclear casualties is easier than the management of victims of biological and chemical events, because radioactive materials and ionizing radiation can be detected and quantified quite easily. Unlike mechanical trauma or thermal injuries, radiation-induced injuries and illnesses almost always are delayed from hours to days, sometimes even weeks to months after the event. This constitutes one of the biggest differences in the care of radiological casualties versus the care of many other types of casualties.

Without awareness of an incident, or without portal or other radiological detectors in place, radiation exposures could go undiscovered until the victims manifest symptoms. The consequences of contact with radioactive sources include injuries to the skin (cutaneous syndrome) and underlying tissues (acute

local radiation injury) and/or acute radiation syndrome (ARS). Management of victims of a radiation exposure depends on how soon after the incident that the victims seek health care. Radiation injuries may not appear for days to weeks after the radiological insult and may progress at a rate dependent upon the radiation dose, the speed at which the dose is delivered (i.e., the dose rate), the type and quality of radiation involved, and the amount of tissue irradiated. The higher the dose of radiation absorbed, the earlier the appearance of the symptoms and signs of radiation injury/illness. The severity of the symptoms and signs usually determines when and how radiological victims present to the medical community; victims with severe symptoms likely will present to a hospital emergency department. Another important factor is whether or not the victims know that there has been a radiological incident. Victims who know that they have been involved in a radiological incident are likely to present to an emergency department because of anxiety and fear; victims who don't know that they have been involved in a radiological incident are likely to seek care from their personal care providers.

When a radiological/nuclear incident is known to have just occurred, the hospital and staff must prepare for the arrival of potentially large numbers of contaminated victims. Staff preparations begin with activating the Radiological Emergency Response Plan and the Emergency Reception Team (ERT). Depending on the number and acuity of victims expected, the members of the Emergency Reception Team may vary in number, capabilities, and nursing/medical specialties (e.g., nurse anesthetists, anesthesiologists, or surgeons). The make-up of the team is defined in the hospital's Radiological Emergency Plan, which details the roles and responsibilities of team personnel and immediate supervisors, with assigned duties fitting into the hospital's Incident Command System (ICS).

The size of the ERT should be restricted to the minimum required to avoid overcrowding in the RTA, and to minimize the number of personnel who might become contaminated. All personnel and equipment exiting the RTA must be radiologically surveyed (i.e., checked with radiological detection equipment) if contamination has been an issue. Egress procedures can be tedious and occasionally require additional personnel, but are necessary to contain contamination within the RTA.

Table 13.2 provides an example of the various roles and responsibilities of members of an ERT and lists the essential radiological emergency responses.¹⁵ As with other events, information as to the number of victims, the acuity of the victims, the mechanism of injury, and the estimated time of arrival (ETA) to the hospital should be conveyed to the receiving hospitals. Utilizing the incident command structure and communications system, nursing staff should continue to gather information about the incident. Additionally, nursing personnel and other hospital staff should attempt to ascertain whether the victims

EMERGENCY MANAGEMENT OF RADIATION INJURIES AND ILLNESSES

TEAM MEMBER	DUTIES
Team Coordinator	Serves as the officer-in-charge and facilitates/coordinates healthcare delivery efforts (may be the Emergency Department charge nurse)
Triage Officer	Performs medical screening, triage, and prioritization of victims
Team Physician	Diagnoses, treats, and directs patient care
Team Nurse	Performs nursing diagnoses Assists with medical procedures, collects specimens, performs radiological monitoring and decontamination procedures Frequently reassesses patient's needs and intervenes appropriately
Radiation/Survey Technician	Performs radiological surveys of victims, ERT members, the RTA, and equipment Monitors personal dosimetry devices Maintains survey equipment Guides radiological monitoring and decontamination efforts
Technical Recorder	Maintains a critical event log Documents medical and radiological data
Nursing Circulator	Works outside the RTA to provide logistics support Provides medical specialty items and supplies Coordinates additional hospital resources
Public Information Officer	Disseminates information releases in coordination with other designated healthcare officials and hospital management
Administrator	Coordinates the overall facility response and assures the continuance of healthcare operations
Adjunct Medical Team Members	May include laboratory, radiology, and nuclear medicine technicians, and respiratory therapists May or may not be required to function within the RTA
Maintenance Personnel	Assists in the preparation of the RTA by removing unnecessary equipment, posting signage, erecting control lines, and applying floor covering Places high-efficiency particulate air (HEPA) filters over existing air returns.
Security Personnel	Establishes restrictive perimeter and manages traffic flow into and around the RTA
Psychosocial Support Personnel	Provides support to patients, family members of patients, or staff affected by the incident

Table 13.2: Duties of members of the hospital Emergency Reception Team (ERT) in the Radiation Treatment Area (RTA)¹⁵ (Used by permission)



Photo courtesy of DM Christensen

Figure 13.1: Preparation of a room for management of injured and radioactively contaminated patients. Note the butcher paper taped to the floor to clearly identify the area and to provide a visual clue to persons who might attempt to enter as well as identify clearly where contamination might land on the floor. The nurses are placing three to four waterproof sheets on the gurney to help prevent contamination of the gurney from contaminated body or irrigation fluids.

of a radiological incident have simply been exposed or whether they have been contaminated and, if so, with what radioactive material.

Contaminated patients should be treated in a separate area that can be isolated and cordoned off, such as an RTA, to limit the spread of contaminants. Thus, facility preparations for receiving radiologically-contaminated victims include the designation of one or more treatment rooms that are prepared with floor coverings (e.g., butcher block paper taped to the floor). This not only provides a visual clue as to the location of the designated treatment area, but it also facilitates clean-up (Figure 13.1). Any unneeded equipment should be removed from the room or covered with a protective covering. Control lines should be demarcated to limit access and egress to and from the treatment area. Monitoring of all personnel and equipment leaving the radiation treatment area is required.

Uncontaminated victims and those who have simply been exposed or irradiated can be treated in the hospital's main treatment area, such as the Emergency Department (ED). No special preparations of the facility or personnel are required other than those ordinarily implemented for potential exposure to blood-borne pathogens. However, unstable patients or patients with unanticipated radiological injuries or illnesses can end up in the main ED before it is determined that they have been radiologically contaminated. This

necessitates surveying and decontaminating of the entire area and all involved healthcare personnel.

Radiation Protection

The mnemonic “*ALARA*” is an acronym for “As Low As Reasonably Achievable”, and is a useful way to remember that the risks posed by ionizing radiation can be reduced or minimized in four ways:

- Decrease the *Time* spent in the presence of radioactive materials;
- Increase the *Distance* from radioactive materials;
- Increase *Shielding*; and
- Decrease the *Quantity* of radioactive materials by containing and controlling them.

The implementation of these principles is relatively simple, but they are unfamiliar to most healthcare practitioners; therefore, they must be practiced regularly. The implementation of simple contamination control procedures, similar to those used in caring for a patient in medical or reverse isolation, are sufficient to allow care to be rendered without widespread and undue concern for contamination issues.

If first responders inform the ED that arriving victims are contaminated with radioactive materials, receiving personnel should plan on providing care using universal precautions, sterile techniques, and personal protection equipment (PPE), including surgical scrub suits and gowns, shoe covers, nitrile gloves, splash shields, facemasks, and head covers. Double-gloving is recommended for handling any kind of contamination, including radioactive materials. Double-gloving also facilitates changing gloves without the potential for contaminating bare hands, particularly if the first pair of gloves is taped to the wrists. Other additional PPE measures may include the use of Tyvek® garments, or other relatively impermeable coveralls and boots. Also, the standard surgical mask may be substituted with an N-95 or N-100 face mask. This precaution rarely is necessary unless it is known that particulate *airborne* radioactive contaminants are present; this is not likely. However, the potential mixture of biological or chemical hazards with radiological agents may dictate more stringent respiratory protection. In some cases of mixed contamination, powered air-purifying respirators may be needed. If available, self-reading radiation dosimeters also should be issued to the ED staff.

Utilizing planned and rehearsed actions, hospitals should dedicate a specific entrance and traffic flow pattern for contaminated victims, as long as they are medically stable. If the victim’s condition is or becomes unstable, prompt medical stabilization should occur without consideration for the contamination. Again, universal precautions, sterile techniques, and the use of PPE generally will be protective.



Figure 13.2: A pancake probe (A) is connected to the detection device containing the electronics for radiation detection and quantification (B). The numbers of radioactive disintegrations are tallied by the counter in counts/minute (cpm).

Radiological Survey

A radiological “survey” is the methodical scanning of equipment, facilities, and/or personnel with a special detector. One of the most commonly used radiological detectors is the Geiger-Muller (GM) counter. The detection end of the GM counter, known as a pancake probe, is held about 1.25 centimeters from the surface of the object being surveyed and moved over the surface at a rate of 2.5–5 centimeters/second (Figure 13.2). Nuclear medicine personnel can train hospital and ED nursing staff on the use of the GM counter. Special physics expertise is required to convert the reading to the radiation dose measurement.

Another type of detector that often is used is a dose-rate meter. This detector looks much the same as the meter in Figure 13.2, except that the readings

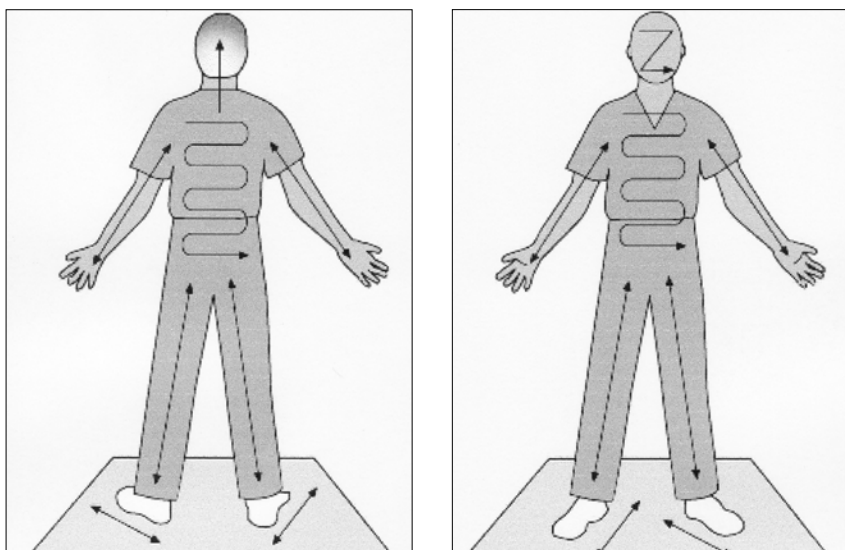


Figure 13.3: Pattern for performing radiological surveys of patients and personnel

are in Roentgen/hour, milliRoentgen/hour, or microRoentgen/hour (a Roentgen is a measure of ionizations in air), but can be read as “rads/hour”, “millirads/hour”, or “microrads/hour”. Thus, this dose-rate meter can be used for determining the radiation dose an individual might be receiving in a given time-frame. For example, if the meter reads 1,000 millirads/hour at a certain distance from the radiated subject, and a healthcare provider spent 30 minutes at that distance caring for the patient, he/she would receive 500 millirads (0.5 rad, or 500 millirem), which is a medically insignificant dose. In the United States, the occupational exposure limit for radiation workers is 5,000 millirem/year.

Radiological surveys of patients and healthcare personnel include the methodical assessment of every square centimeter of body surface in the manner previously described following the pattern illustrated in Figure 13.3. Patients on gurneys or beds must be log-rolled in order to survey their back and buttocks and positioned appropriately to survey hard-to-get to areas, such as the axillae and perineal area.



Photo courtesy of DM Christensen

Figure 13.4: This photograph illustrates the prioritization process for patient management. Note that the health physicist is surveying an open wound on the victim's leg while taking care to avoid interference with healthcare personnel who are performing their assessments for medical and surgical conditions. Many physics, medical, and nursing activities take place simultaneously as with any other injured victim.

Radiological Care Priorities

The overall first priority of care of radiological casualties is stabilization of any medical and surgical conditions. *Life- and limb-threatening injuries take absolute precedence over radiological issues.* As life- and limb-threatening conditions are managed, radiological issues rise in priority. Figure 13.4 depicts the prioritization of care of a radiologically contaminated patient.

If radiation exposure is known or suspected, the first radiological priority is to determine if the patient is contaminated and, if so, to determine the level and route of contamination. The second radiological priority is to decontaminate wounds, nose, mouth, and skin, in that order, while pursuing identification of the contaminant. The third radiological priority is to begin therapy for the mobilization and elimination of internal contamination, if present. This step is time-critical, can be complex, and likely requires expert assistance. The management of internal contamination is discussed in more detail later.

A challenge arises when victims present to the hospital before it is known that there has been a radiological incident. Because many radiation injuries and effects can masquerade as common illnesses, it is easy for them to go undiagnosed or misdiagnosed. Clues garnered from the medical history may lead to a diagnosis of radiation illness, but only if it is included in the differential diagnosis; otherwise, these situations may not be detected early.

After the patient has been disrobed and placed on a clean surface, the radiological survey with a GM counter is repeated beginning with assessment of any open wounds, and then proceeding to the face. Nose and mouth swabs should be obtained and surveyed for contamination using the GM, particularly if the facial survey indicates contamination. It is highly unlikely that there will be significant internal contamination via the nose or mouth if the facial survey is negative. However, the potential for internal contamination is high if mouth and nasal swabs reveal the presence of radioactive material. Nose and mouth swabs obtained >1 hour after the incident may read as negative on the GM counter, in spite of the possibility of internal contamination. Also, alpha-emitters in body fluids may not be detectable by the GM, as they are shielded so easily. Therefore, oral and nasal sample swabs should be allowed to dry before being surveyed, if the radioactive material has been identified as an alpha-emitter. Once nose and mouth samples are collected, the remainder of the body should be surveyed as illustrated in Figure 13.3. Levels of contamination at each location should be documented.

The magnitude of internal contamination of a patient can be estimated from the number of counts/minute detected in wounds, the nose, and the mouth. Physics personnel familiar with the required calculations will be needed to interpret these results for healthcare personnel. If physics personnel familiar with dose estimations are not available on-scene, specialized personnel at the Radiation Emergency Assistance Center/Training Site (REAC/TS) are available 24 hours each day, seven days every week to provide advice and consultation anywhere in the world. (REAC/TS, US Department of Energy Oak Ridge Operations: +1-865-576-1005).

Decontamination

Most incidents involving contamination with radioactive materials are not particularly hazardous for healthcare workers or victims; much of the risk can be mitigated by following the principles of ALARA, by using sterile techniques, and by wearing appropriate PPE, as previously discussed. However, attempts must be made to avoid spreading radioactive materials.

Ideally, first responders will have attempted to decontaminate non-critical victims at the scene or at a designated decontamination center outside of the hospital. However, medically unstable victims or those with serious injuries should receive necessary medical care prior to undergoing decontamination. The meticulous and time-consuming process of decontamination should be initiated after the patient is stabilized. Priorities are the same as for the radiological survey, i.e., areas of contamination in and around open wounds should be decontaminated first, followed by the facial orifices (the nose and mouth). Intact skin is the final decontamination priority.

Decontamination of open wounds involves the same techniques used for care of any other laceration or puncture wound. The wound site is prepared with a drape, preferably an adhesive-backed, fenestrated paper drape that will not absorb irrigation fluid. The wound then is irrigated gently using sterile water or normal saline, taking care to prevent the introduction of other contam-



Photo courtesy of DM Christensen

Figure 13.5: Irrigation of an open contaminated wound showing methods used to prevent further contamination of the patient. The assistant is holding two absorbent pads around the wound to prevent fluid from flowing onto the gurney or the floor. The decontamination of an open wound with gentle irrigation is done before more vigorous attempts to decontaminate for biological agents. A complete demonstration of patient decontamination procedures may be found at <http://orise.orau.gov/reacts/guide/procedures.htm>.

inants, tissue damage, or splashing of the irrigation fluid onto adjacent body parts. Vigorous scrubbing should be delayed until any potentially radioactive foreign bodies have been removed. The run-off of the contaminated irrigation fluid should be controlled by directing it into a disposable plastic bag inside a waste container. The patient should be positioned in a way that allows gravity to direct the flow of the contaminated fluid into the container (Figure 13.5). Failure to properly drape and position the patient may result in cross-contamination and the inadvertent spread of contamination to other body areas previously not contaminated. In emergency situations requiring urgent decontamination for other reasons, such as chemical contamination, wounds can be irrigated directly over a sink.

After decontaminating open wounds, attention should be directed to areas of contamination in or around body orifices. Contamination around the nose or mouth is challenging as the decontamination process actually may intensify the problem rather than alleviate it. Nasal irrigation carries the risk of inadvertent inhalation or ingestion of contamination; for this reason, nasal irrigation is generally not recommended. Expectoration may produce contaminated mucus that should be surveyed and its reading documented. A cooperative patient may blow his/her nose in an attempt to remove nasal contamination. Eye irrigations may be performed using the Morgan Lens® or simple intravenous infusion administration tubing. The eye should be irrigated away from the nasolacrimal duct, taking care to protect the ear canal from collecting potentially contaminated run-off fluid.

Lastly, localized areas of skin contamination can be decontaminated by washing with water and soap; baby shampoo or dish-washing detergents are excellent cleansing agents. Degreasing agents or solvents such as GoJo® or acetone should *not* be used as defatting of the skin can facilitate percutaneous absorption of contaminants. The skin should be scrubbed assertively, but not too aggressively, to avoid irritation or abrasions to the skin that could allow internalization of radioactive contaminants. Hair, beards, mustaches, and eyebrows can be shampooed; avoid shaving, which can cause microabrasions that may allow absorption of contaminants. Do not cut eyebrows as they may not grow back.

In general, total body showering is not warranted as it may cause the spread of contamination to other uncontaminated body parts. However, total body showering may be warranted for widespread body contamination or for victims of a mass-casualty radiological incident when resources are not available to perform thorough radiological surveys of individual patients. Decontamination priorities always are determined by the level of threat posed by the most hazardous agent involved. Thus, mixed contamination with radiological and chemical agents may necessitate total body showering

as the chemical agents potentially can be far more hazardous than the radioactive materials.

Each decontamination process should be followed by a repeat radiological survey to determine the effectiveness of the decontamination effort. Ideally, decontamination should be continued until radiation readings are no greater than two to three times the background radiation levels, or until the best reading is achieved without causing skin damage, as evidenced by erythema or abrasions. Areas of the body that cannot be completely decontaminated can be covered with a large, absorbent pad and wrapped in plastic for 12 hours. As the wrapped part of the body sweats, the contamination will be absorbed by the pad, which then can be discarded as radioactive waste. A radiological survey must then be repeated to determine residual levels of contamination.

The process of radiological decontamination is repetitive and laborious with a large expenditure of medical supplies and the generation of both biological and radiological waste. Careful documentation is required and is best accomplished through the use of a designated recorder similar to that used during cardiac resuscitation efforts. The documentation also serves as a secondary reference for the chain-of-custody process. In criminal or terrorist incidents, all collected materials and documents may become forensic evidence.

Before removing the patient from the treatment area, she/he should be log-rolled onto a clean surface where a final radiological survey is conducted. The staff also must be surveyed prior to leaving the treatment area to avoid the spread of radioactive contamination. And, finally, all equipment, supplies, and the treatment areas must be surveyed and decontaminated, as necessary. If the patient is to be admitted to the hospital, the receiving floor personnel will need instructions on caring for the patient and the proper handling of any dressings that may contain residual contamination. Patients that are to be discharged from the hospital will need similar instructions as well as follow-up appointments.

Health Physics Assistance

Health physicists (HPs), known as medical physicists in healthcare settings, are specialists in radiation protection and contamination control and should be integrated into all planning and preparations for a radiological/nuclear incident. In addition to providing guidance for contamination evaluation and control, these specialists can help reconstruct an incident and provide an estimate of the radiation dose and the identity of radioactive materials or radiation(s) involved. Their skills also can be valuable in educating healthcare personnel about the medical management of radiation injuries and illnesses.¹⁶

Healthcare Management

In managing an incident involving radioactive materials, various steps must be carried out, even if the exact nature and history of the incident is not yet fully

elucidated. Some of the steps may not always be required, but should be considered. Although a health/medical physicist is able to assist healthcare providers in determining the needs based on radiological conditions, the final decision regarding care and management is the responsibility of the medical staff. The following checklist outlines a basic plan of action.¹⁵

Prior to the arrival of victim(s):

1. Get the incident and medical histories from the site to determine if victims are contaminated or irradiated (exposed) or both;
2. Activate the Radiological Emergency Response Plan and the ERT, and prepare the designated RTA; and
3. Summon physics support identified in the Radiological Emergency Response Plan.

Upon arrival of victim(s):

1. First priority: stabilize life- or limb-threatening medical and surgical conditions;
2. Obtain histories (medical, nursing, and incident); specifically inquire about the time of onset and severity of nausea/vomiting, if present, which might be used to estimate radiation dose;
3. Determine if the victim is contaminated; disrobe the victim and place him/her on clean, water-proof sheets;
4. Carefully contain all contaminated clothing in double plastic bags;
5. Save contaminated clothing and dressings for further radiological analyses and possible forensic evidence; identify with patient name, identifier, date and time of collection, and name and identifier of collector;
6. Complete medical and nursing assessments, including vital signs and patient's weight;
7. Perform baseline radiological survey beginning with open wounds, mouth, nose, and, lastly, the skin;
8. Obtain nose and mouth swab samples for radiological survey; if positive, have victim attempt nose blows and expectoration to eliminate contamination;
9. Perform radiological survey of swab samples; if positive, send to previously identified physics laboratory;
10. Collect and contain all wound dressings, survey for contamination, and send to designated physics laboratory;
11. Obtain laboratory and x-ray assessments as required:
 - Complete blood count (CBC) with absolute lymphocyte and absolute neutrophil counts (ALC and ANC) stat, every six to eight hours during the first day, then every 12 hours for the next two days, and daily thereafter;

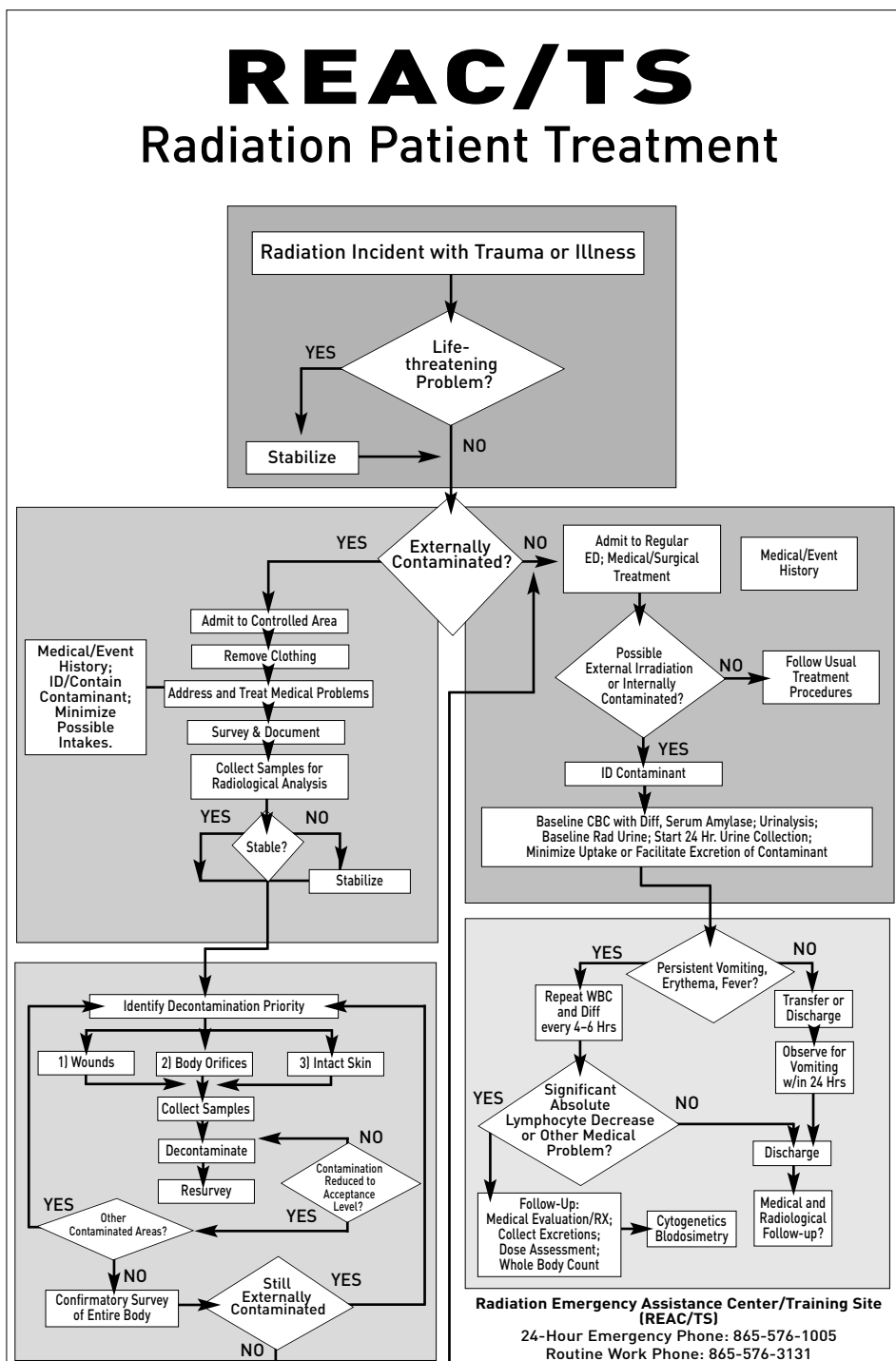


Figure 13.6: The Radiation Emergency Assistance Center/Training Site (REAC/TS) patient treatment algorithm¹⁵ (Used by permission)

- Type blood — hold for cross-match unless required for bleeding or trauma;
 - Amylase (serum or preferably alpha or salivary) — interpret carefully in the presence of head, face, neck or abdominal trauma;
 - Cytogenetic biodosimetry chromosome aberration analysis (draw blood into lithium-heparin [green-top] hematology tube — do not refrigerate; send to previously identified laboratory);
 - Urine sample for radiological survey — if positive, send to designated physics laboratory for identification of the radioactive material. The detection of radioactivity in a urine sample confirms internal contamination; failure to detect radioactivity does not rule out internal contamination. Be aware of possibility of the cross-contamination from hands or container; and
 - 24-hour urine and fecal collections for radioassays by designated physics laboratory.
12. Summon expert medical, nursing, surgical, and/or psychosocial support staff as previously identified; and
 13. Contact national or regional organizations that specialize in managing radiation incidents and treating radiation injuries and illnesses for consultation.

Figure 13.6 contains an algorithm to guide care of radiological victims.

ACUTE RADIATION SYNDROME (ARS)

Acute radiation syndrome (ARS), formerly called radiation sickness, is an acute illness that can develop after exposure of a significant portion of the body to high doses of penetrating radiation over a short period of time (i.e., minutes).¹⁷ The severity of the illness increases with the radiation dose, the amount of the body exposed, and the penetrating capacity of the radiation. (Recall that gamma rays, x-rays, and neutrons have the greatest penetrating capability.)

Acute radiation syndrome follows a predictable course lasting from a few hours to several weeks. While all living cells have some sensitivity to ionizing radiation, some cells are more sensitive than others.¹⁸ Cells that are actively dividing, cells that are undifferentiated, and cells that are very metabolically active generally are most sensitive to radiation damage. One exception is circulating peripheral lymphocytes, which are among the most radiosensitive cells in the body. Stem cells and precursor cells, such as spermatogonia (precursor cells of sperm) and myelo-blasts (bone marrow stem cells), are fairly radiosensitive, although damage to these cells does not become manifest for days or weeks after a radiation injury. The precursor cells of tissues that comprise body barriers, such as the skin, the mucosal linings of the gastrointestinal system, respiratory tract, and small blood vessels, are less radiosensitive

PHASE	SYMPTOMS	COURSE	COMMENT
Prodromal phase	Nausea, vomiting, fatigue, diarrhea, possibly a low-grade fever, and loss of appetite	Signs and symptoms may disappear within hours to days	The higher the radiation dose, the earlier the onset of symptoms
Latent phase	None	Symptoms disappear within hours to several days after exposure	The higher the radiation dose, the shorter the duration and the later the occurrence of the latent phase; the absence of a latent period is not a good sign and indicates a high dose of radiation
Manifest illness phase	Symptoms relate directly to the cells and tissues damaged	Depends on radiation dose and sensitivity of cells affected; may not occur at low doses of radiation	
Hematopoietic Syndrome	Immunodeficiency with infectious complications and impaired wound healing, bleeding, anemia	Initial symptoms may occur within 1–2 hours of exposure lasting for hours up to 2 days; latent stage 1–6 weeks; symptoms may not manifest until several weeks after exposure	Associated with doses of at least 100 rad (1 Gray); higher doses result in more severe effects, including death
Gastrointestinal Syndrome	Altered intestinal motility, vomiting, diarrhea, bloody diarrhea, fluid and electrolyte loss. Sepsis and renal failure may develop leading to cardiovascular collapse and death	Initial symptoms within hours of exposure; manifest illness symptoms within <1 week of exposure; death may occur within 2 weeks of exposure	Associated with doses of 600–800 rad (6–8 Gray)
Cerebrovascular/Central Nervous System Syndrome	Vomiting, diarrhea, confusion, disorientation, cerebral edema, hypotension, and hyperpyrexia	Initial symptoms within minutes of exposure; Manifest illness symptoms occur within hours of exposure; death usually occurs within days	Associated with very high doses of 3,000–5,000 rad (30–50 Gray); fatal within a short period of time
Cutaneous Syndrome and Acute Local Radiation Injury	Uncomfortable skin sensations, swelling, exfoliation, erythema, dry and wet skin sloughing, blister formation, ulceration, and radionecrosis	Initial symptoms of skin sensations and erythema disappear, are brief, and recur within days to 2–3 weeks after exposure, if threshold reached.	Signs depend on radiation dose (See Table 13.4.)

Table 13.3: The signs, symptoms, and course of illness of the phases and organ-specific subsyndromes of acute radiation syndrome (ARS)

than the aforementioned cells. Significant damage to these cells occurs at high radiation doses much later — up to weeks after the insult.

The phases that define the course of the ARS include: (1) the *prodromal phase*; (2) the *latent phase*; and (3) the *manifest illness phase*. The associated

signs and symptoms as well as the general course of each of these phases are outlined in Table 13.3. During the manifest illness phase, patients suffering from ARS can manifest various symptoms and signs that relate directly to the types of cells and tissues that are damaged, resulting in organ-specific subsyndromes. (See Table 13.3.) The *hematopoietic syndrome* occurs with radiation to the sensitive blood-forming organs resulting in deficiencies of white blood cells (WBC) including the lymphocytes. The *gastrointestinal syndrome* of ARS occurs with high doses of radiation that destroy the cells lining intestinal crypts, damage the intestinal microcirculation, and cause the loss of the mucosal barrier. The likelihood of recovery from the gastrointestinal syndrome is further diminished if the hematopoietic syndrome has not been successfully treated.

The *cerebrovascular/central nervous system syndrome*, sometimes called the neurovascular syndrome, can occur following very high doses of radiation that cause damage to the central nervous system. This syndrome is fatal within a short period of time.

SIGN	THRESHOLD DOSE
Epilation (loss of hair)	300 rad (3 Gray)
Erythema (redness of the skin)	600 rad (6 Gray)
Dry desquamation (sloughing)	1,000–1,500 rad (10–15 Gray)
Wet desquamation (sloughing with exudate) and bullae (blister) formation	>2,000 rad (>20 Gray)
Ulceration/radionecrosis	3,000–5,000 rad (>30–50 Gray)

Table 13.4: Approximate radiation dose thresholds for skin injuries

The *cutaneous syndrome* and *acute local radiation injury* can occur with varying radiation doses, as outlined in Table 13.4. Injury to large areas of skin that are shallow and isolated without damage to deeper structures constitute the cutaneous syndrome. Higher doses and more penetrating radiations cause progressively deeper injury to subcutaneous tissues including the microvasculature; this is referred to as acute local radiation injury. Cutaneous damage can progress from recurrent erythema to sloughing, called desquamation. Radiation damage to the skin is unlike mechanical trauma or thermal burns in that the manifestations of significant radiation damage are always delayed. The early appearance of an erythema *that persists* is a sign of a large, acute dose of radiation to the skin. However, if there are *immediate* signs of skin damage following a radiological or nuclear event, i.e., within minutes to hours, they probably are the result of physical trauma, chemical injury, or thermal burns rather than from radiation injury.

Management of Acute Radiation Syndrome (ARS)

If the radiological/nuclear incident has occurred only hours prior to a victim's arrival, the symptoms and signs of ARS, cutaneous syndrome, or acute local radiation injury may not yet be manifest. If the incident has occurred several days or more prior to the time the victim presents to the healthcare facility, the radiological care plan becomes slightly different. However, in either case, medical stabilization of the victim remains the top priority.

The higher the radiation dose absorbed, the earlier the symptoms and signs of ARS appear. Previously discussed nursing care of victims of ARS in the ED is directed at initial management of other associated conditions, such as mechanical trauma, blast injuries, thermal burns, open wounds, and decontamination. Management of more serious injuries may require treatment in a specialized facility, such as a burn center.

The clinical course of ARS is similar to that of human immunodeficiency virus (HIV) infection with an increased susceptibility to an array of infections. Reverse isolation with strict adherence to sterile technique is required. Prophylactic antibiotics for a variety of viral, bacterial, and fungal infections are standard treatment for patients who have decreased WBC counts. These neutropenic patients are best cared for by nursing personnel familiar with the management of hematology/oncology cases. Specific foci of infection are managed as in any other setting; infectious disease specialty consultation will be needed.

The occurrence of vomiting early in the hematopoietic syndrome usually is short-lived, in the order of hours to days, but it can be severe. Commonly used antiemetics, such as promethazine or prochlorperazine, are not very effective for radiation-induced vomiting; 5-hydroxy-tryptamine³ (5HT₃) receptor antagonists, such as granisetron or its congeners, may be needed.

In the initial phase of ARS, blood products, such as packed red blood cells and platelets, are required only for trauma patients or patients with thermal burns. However, weeks after the event, blood products may be required for the treatment of anemia and thrombocytopenia associated with the hematopoietic syndrome. Cytokines, sometimes called growth factors, may be valuable in the management of the hematopoietic subsyndrome as they stimulate proliferation and maturation of stem and precursor cells. Deep bone pain following the administration of cytokines can occur and may require aggressive pain control with narcotics. Nursing management consists of supportive care aimed at managing personal hygiene and relieving symptoms, including pain.

The incident history and dose reconstructions performed by health physicists will be used to guide the medical management of radiation-induced injuries and illnesses. "Clinical dosimetry" (i.e., the victims' signs and symptoms) also will help estimate the radiation dose received, and can be used to guide treatment efforts. Additionally, "laboratory dosimetry", particularly complete blood

count and absolute lymphocyte count values, will provide further information to guide medical management of radiation-induced injuries and illnesses.

“Cytogenetic biodosimetry” using lymphocyte cultures and chromosome aberration analyses also may be required. This highly specialized test is performed at only a few places, including the Radiation Emergency Assistance Center/Training Site (REAC/TS) Cytogenetic Biodosimetry Laboratory (CBL) in Oak Ridge, Tennessee, United States, and the Armed Forces Radiobiology Research Institute (AFRRI) in Bethesda, Maryland, United States (See Appendix 13.A). These tests are very labor-intensive and the results will not be available for seven days; however, cytogenetic biodosimetry is the “gold” standard of radiation biodosimetry.

General Nursing Considerations

Depending upon the history of the incident and the doses incurred, radiological victims may need to be admitted to the hospital after initial treatment in the ED. If there is the potential for substantial radiation dose (>150 – 200 rad or >1.5 – 2.0 Gray), hospital admission likely will be necessary. The young and the elderly generally will require more intensive medical/nursing care because at the same doses, they tend to become much sicker than do older children, adolescents, and young adults.

Nursing care of patients with impending hematopoietic syndrome is the same as the supportive nursing care for immunologically-compromised patients, such as those with HIV/AIDS, or those receiving some types of chemotherapy. These patients eventually suffer opportunistic infections, re-emergence of dormant, pre-existing viral infections, such as herpes simplex virus (HSV) and cytomegalovirus (CMV), and infections from normal commensal bacteria. Scrupulous attention must be given to care and cleansing of intravenous and urethral catheters and injection sites with strict adherence to sterile procedures and patient hygiene (washing with antibacterial soaps, scrupulous finger- and toenail cleaning, dental hygiene, etc.). As infections are the predominant causes of morbidity and mortality in these patients, reverse isolation in negative-pressure rooms with HEPA-filtration is required. In addition, these immunologically-compromised patients should be served only well-cooked food and avoid eating raw fruits or vegetables. Dietary supplementation, including full parenteral nutrition, may be required for some cases. Patients who have received high doses of radiation may require treatment with blood products for thrombocytopenia and/or significant anemia, and, occasionally, stem cell transplantation.

The care and management of patients with lung injuries from a radiological incident associated with blast forces are not different from the care for those same injuries received from conventional trauma with the inclusion of the care required for internal contamination and the acute radiation syndrome.

TREATMENT OF INTERNAL CONTAMINATION

Treatment of internal contamination and the removal of radioactive contaminants are toxicological challenges. Radioactive materials are metabolized by the body in the same way as their non-radioactive counterparts. For example, radioactive iodine acts the same as non-radioactive iodine, i.e., it is selectively concentrated by the thyroid gland. The incorporation of some radionuclides into critical or target organs can occur within a few hours of intake. The incorporation of radioiodine into the cells of the thyroid gland causes the nearby tissues to become irradiated; the thyroid gland becomes a “source” organ. Rapid removal, or “decorporation”, is imperative because once incorporated, some radionuclides (e.g., bone-seeking alpha-emitters, such as plutonium, americium, and radium) are extremely difficult to decorporate and eliminate from the body. For this reason, the rapid elimination of internalized radioactive material becomes the primary radiological concern, although it cannot be pursued without attending to the first two priorities of determining the level and route of contamination and performing external decontamination. The results of radiobioassays or other laboratory tests to determine the levels of internalized radionuclides will not be available for days. Thus, healthcare practitioners must rely on the health physicist’s initial dose assessments to determine if treatment of internal contamination requires the administration of various medications, such as chelating agents.

Only a few specific antidotes exist for treating internal contamination with radioactive materials. Trisodium diethylenetriaminepentaacetate (DTPA or pentatate) is a chelating agent approved for internal contamination with plutonium, americium, or curium; it is not effective for treatment of internal contamination with uranium. The agent is available in two forms: calcium-DTPA (Ca-DTPA) and zinc-DTPA (Zn-DTPA). Both forms tightly bind radioactive plutonium, americium, and curium, which then are eliminated from the body in the urine. When administered within the first day after internal contamination, Ca-DTPA is about 10–20 times more effective than Zn-DTPA; after 24 hours, Ca-DTPA and Zn-DTPA are equally effective.²⁶ Zinc-DTPA is the form that should be used in pregnant women and children. The medications are provided in vials of 1 gram DTPA in 4 milliliters of solution; DTPA can be administered by intravenous injection of 1 gram (4 milliliters) diluted with 6 ml of normal saline or, preferably, by a 20-minute intravenous infusion of 1 gram (4 milliliters) diluted with 100 milliliters of normal saline. The DTPA also can be administered via a hand-held nebulizer using the full, undiluted contents of a vial of either Ca-DTPA or Zn-DTPA; doses should not be fractionated. Caution should be used in administering DTPA to patients with renal insufficiency. The duration of DTPA treatment can range from one day to weeks or months, and should be guided by radiobioassays or assessments of the level of

radioactive materials in 24-hour urine and fecal samples.

Prussian blue (PB), or ferric III hexacyanoferrate II, is an ion-exchange resin used to decorporate radiocesium as well as non-radioactive and radioactive thallium, and is one of the very few specific antidotes for radioactive materials. Prussian blue binds cesium or thallium in the gastrointestinal tract interrupting its enterohepatic circulation and allowing its elimination in the stool; it colors the stool a bright blue. For patients who have difficulty swallowing pills, the PB capsules can be broken up and mixed in food or liquid. However, the opened capsules cause the patient's mouth and teeth to become blue during the time of treatment. The dose of PB depends on the patient's age and the amount of radiocesium or thallium contamination in the body. Usually, PB is administered three times/day for a minimum of 30 days, depending on the extent of the contamination.

For emergency use, DTPA and Prussian Blue can be made available from the World Health Organization (WHO) Radiation Emergency Planning and Assistance Network (REMPAN) members and REAC/TS (Appendix A). For incidents in the United States involving large numbers of victims, assets can be requested directly by the affected state's governor's office for deployment from the Centers for Disease Control and Prevention (CDC). Medical personnel must coordinate with their state and local public health departments and the state or local Radiation Control Program to request, receive, distribute, and dispense radiological countermeasures contained within the Strategic National Stockpile (SNS).

For victims of radioactive iodine exposure (from a nuclear power plant incident or detonation of a nuclear device), stable iodine, such as potassium iodide (KI), is used to block the incorporation of radioiodines into the thyroid gland. Radioiodines are produced as fission products following a nuclear detonation and may be inhaled or ingested following such an incident. Potassium iodide may be used prior to an anticipated incident, or up to six to 12 hours after an incident. It should be administered as early as possible after an event as it is not very effective after 12 hours, and should not be used after 24 hours of the contaminating incident.

GROUP BY AGE	DAILY DOSE (Milligrams)
Infants <1 month	16
Children 1 month – 3 years	32
Children and teenagers 3–18 years	65
Adults (including pregnant and lactating women and adolescents >68 kg)	130

Table 13.5: FDA dose recommendations for potassium iodide treatment¹⁹

Daily administration of KI in doses indicated in Table 13.5 should continue for seven to 14 days following an incident or until the danger of exposure has passed and/or other measures (evacuation, sheltering, control of the food and milk supply) have been implemented successfully. Potassium iodide is available as tablets or in a liquid form to be administered orally. Hospitals located in proximity to nuclear power plants should have stock supplies of KI available.

In the United States, the CDC's SNS is a national repository of antibiotics, chemical antidotes, antitoxins, life-support medications, intravenous administration supplies, airway maintenance supplies, and medical/surgical items. It also includes a variety of decorporation agents, such as chelating agents, cytokines, pain medications, antiemetics and topical burn cream. Additionally, the SNS has fluid-replacement products, gauze dressings, and laceration repair supplies for burn and blast victims. Medications and medical supplies also can be accessed from collaborators in the WHO REMPAN (Appendix A). The REAC/TS is one of the REMPAN Collaborating Centers that maintains smaller stockpiles of some chelating agents in Oak Ridge, Tennessee, United States, and with many co-investigators. These can be, and are, deployed upon request with the US Department of Energy approval.

General Surgical Considerations

Necessary surgical procedures should be performed either very early after a radiological insult, preferably within 24–36 hours, or later, after resolution of the hematopoietic consequences. Surgical procedures performed after 36–48 hours from the time of a substantial radiation injury may be complicated by failure to heal and a variety of infections. In general, surgery should be avoided until four to six weeks after recovery from the hematopoietic subsyndrome. Emergency surgery, however, must be performed at any time needed.

Because of the potential for perforation, endoscopies are discouraged >48 hours after a significant radiation exposure to the GI tract. The timing of the surgical removal of shrapnel from a radiological victim depends upon the physical harm it represents to vital structures as well as its radiological hazard. Surgery to remove imbedded radioactive materials may require the use of long-handled instruments to increase the distance between the healthcare personnel and the radioactive material. Ring dosimeters should be worn by all participating staff to estimate the radiation dose to caregivers during the surgery. To prevent further exposure of personnel, the removed radioactive shrapnel can be placed in a lead container available from the nuclear medicine department.

Some trauma-induced wounds can be surgically debrided and repaired following cleansing of the wounds. Contaminated burned tissue initially is managed with irrigation and debridement. As eschar forms or more tissue becomes devitalized, radioactive contamination will be removed with the

eschar and/or debris. Wet-to-moist or wet-to-damp dressings may be used to assist with debridement; wet-to-dry dressings may cause damage to vital tissues. The use of pulsed lavage devices applying pressurized saline to the wound surfaces, followed by suctioning, are becoming prevalent. Waste from any of these techniques needs to be handled as contaminated waste. Other techniques, such as enzymatic or autolytic wound debridement, may be undertaken by experienced nursing staff in some institutions.

Psychosocial and Communication Issues

Along with the medical challenges they pose, incidents involving radioactive materials can have profound psychosocial effects with important implications for healthcare providers. Research, as well as experience, have shown that radiation is among the most feared of all hazards, and situations involving radiation and radioactive contamination have the potential to produce widespread fear.²⁰ Among the many behavioral responses that have been noted during radiological/nuclear incidents are stress-induced physical symptoms that mimic the symptoms of radiation exposure; these responses can pose major challenges for healthcare providers. Thus, it is essential to integrate psychosocial issues into radiological incident response plans, training programs, and training exercises.^{21–23} Useful guidance can be found in such publications as the National Council on Radiation Protection and Measurements' *Management of Terrorist Events Involving Radioactive Material*⁸ and *Medical Management of Radiation Accidents*.²⁴

Along with medical countermeasures and psychosocial support, effective communication with the public is crucial following a radiological event.^{4,20,23} Providing factual information that will enable individuals to make appropriate, protective decisions and to follow recommendations by medical staff and other health professionals is essential to the success of any response and recovery effort. Likewise, effective communication with healthcare professionals and hospital staff is crucial. Many staff members will have only limited familiarity with, and knowledge of, radiological issues; it is important to provide scientifically accurate, comprehensible information in a timely fashion. Various informational materials and useful research-based guidance on effective communication during radiological emergencies may be found at the US Department of Health and Human Services Radiation Event Medical Management Website (www.remm.nlm.gov/remm_pio.htm) and at the Website of the CDC (<http://emergency.cdc.gov/radiation/>).

POPULATION MONITORING

Depending on the nature and scale of an incident involving radioactive materials, it may be necessary to screen and assess large numbers of people for pos-

sible exposure to radiation or possible contamination from radioactive materials. Termed *population monitoring*, this process of identifying victims, screening them, and arranging appropriate follow-up, requires the involvement of a variety of healthcare professionals. Healthcare facilities in jurisdictions nearest to the incident will be the first recipients of contaminated, injured victims, or others seeking medical advice concerning possible radiation exposure or contamination. Population monitoring begins immediately after a radiological or nuclear incident is disclosed and continues until all affected people have been monitored and evaluated for:

- Significant medical/surgical conditions;
- The presence of radioactive contamination on the body or clothing;
- The intake of radioactive materials into the body;
- The removal of external or internal contamination (decontamination);
- The radiation dose received and the resulting health risk; and
- Long-term health effects (usually determined through population registry and/or epidemiological investigations).

The use of medical countermeasures for individuals suffering internal radiation contamination is another important issue in radiological population monitoring. Decisions about treatment criteria, as well as the availability and distribution of countermeasures, will be key considerations. Given these responsibilities, nurses, physicians, and other medical staff need education, training, and informational materials to plan and prepare for population monitoring. The guide entitled *Population Monitoring in Radiation Emergencies*²⁵ may be useful in this regard (www.bt.cdc.gov/radiation/pdf/population-monitoring-guide.pdf).

CONCLUSION

Stabilization of life- or limb-threatening conditions is the initial health concern in victims of a radiological or nuclear incident. The body's response to radiation injuries and illnesses almost always is delayed and rarely is immediately life-threatening. If victims are contaminated, the most urgent radiological priorities, after protection of staff and other patients, are identification of the radionuclides, removal of radioactive foreign bodies, determination of the extent of internal contamination, and treatment of internal contamination with appropriate antidotes and toxicological methods. Psychosocial and communication issues also are important. Radiation-affected patients, even if contaminated, can be managed relatively safely by following radiation protection and contamination control guidelines.

Health/medical physics expertise is essential to the effective management of radiological victims. Nursing staff on medical or radiation oncology services may provide additional expert assistance. Nuclear medicine, medical oncology and radiation oncology technicians and specialists also may be of assistance. In addition, guidance should be sought from specialist groups, such as REAC/TS and the CDC. Such guidance is especially important in the event of a large-scale emergency or terrorist event, which likely will pose significant challenges to healthcare facilities. Success in managing the medical consequences of a radiological or nuclear incident depends on effective planning and training. Thoughtful and thorough preparations must be made well in advance to identify resources, both material and human, that must be brought to bear in the emergency setting.

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INTERNATIONAL DISASTER NURSING

Appendix 13A: Resources and Information

RESOURCE	MATERIALS	ACCESS INFORMATION	COMMENTS
Radiation Event Medical Management (REMM)	State-of-the-art guidance for healthcare providers about clinical diagnosis and treatment during mass-casualty events involving radioactive materials	www.remm.nlm.gov/index.html	Developed by the US Department of Health and Human Services with the National Library of Medicine and input from the National Cancer Institute, the Centers for Disease Control and Prevention, and many US and international consultants
Centers for Disease Control and Prevention (CDC)	Training/informational materials, including management of large-scale radiological/nuclear terrorism events, a toolkit for clinicians, a webcast on the medical response to nuclear/radiological terrorism, a "just-in-time" training video, and a clinician pocket guide	www.bt.cdc.gov/radiation	
Radiation Emergency Assistance Center/ Training Site (REAC/TS)	Immediate assistance in the US; Educational materials, a primer on basic physics concepts relevant to radiation emergencies, and demonstrations of decontamination and the donning and doffing of decontamination clothing	(1) 856-576-1005 (US Department of Energy Oak Ridge Operations Office) www.orise.orau.gov/reacts	24-hour/day staffed radiological assistance
US National Council on Radiation Protection and Measurements (NCRP)	Information on the clinical management of internal contamination with radioactive materials (Reports #65 and 138, and Commentary #19)	See Reference Numbers 26, 8, and 9	
International Commission on Radiological Protection	<i>Protecting People Against Radiation Exposure in the Event of a Radiological Attack and Generic Procedures for Medical Response during a Nuclear or Radiological Emergency</i>	See Reference Numbers 27 and 28	<i>Generic Procedures for Medical Response during a Nuclear or Radiological Emergency</i> jointly prepared by the World Health Organization and the International Atomic Energy Agency
The Centers for Disease Control and Prevention (CDC)	24 hour/day staffed, international radiological emergency hotline	(1) 770-488-7100 (Emergency Operations Center)	
World Health Organization (WHO) Radiation Emergency Planning and Assistance Network (REMPAN)	Assistance 24 hours/day, every day	Emergency phone: +41 79 445 15 89 Emergency e-mail: out-break@who.int	
International Atomic Energy Agency (IAEA)	International radiological assistance	+431-2600-0	



CHAPTER 14

EXPLOSIVE EVENT PREPAREDNESS/RESPONSE

Angelo Agostini

DESPITE RECENT CONCERNS about nuclear, biological, and chemical (NBC) weapons of mass destruction, explosions are the most common cause of mass-casualty incidents associated with terrorism. Although most blast events tend to be related to industrial accidents, worldwide terrorism has risen sharply, with 14,966 terrorist events occurring between 01 January, 2003 and 31 December, 2006; bombings comprised 53% of these terrorist events and produced 85% of the injuries caused by all terrorist attacks.¹

For the most part, countries have not balanced their preparedness efforts to properly reflect this increasing threat from blast events. The US government has increased its spending on bioterrorism preparedness, and currently funds more than 50 centers for bioterrorism preparedness.² However, there are no similar efforts for ensuring preparedness for blast events; in fact, funding for any blast preparedness has been almost non-existent.

OBJECTIVES:

- Describe the four categories of blast injuries;
- Understand the mechanics of a blast; and
- Understand the treatment priorities for blast-injured patients.

Healthcare facilities also have not balanced their preparedness efforts to address blast incidents. Plans must be in place to enhance the facility's and the community's level of preparedness for explosive events. Nurses must be made aware of the unique aspects of blast-related injuries, and the triage, diagnostic, and management challenges of caring for these victims.

EXPLOSIONS

Explosions involve the transformation of explosive substances from a solid or liquid state to a gaseous state with the release of energy under extremely high pressure. A large amount of heat and gaseous products are transmitted from the site of the explosion, moving outward in every direction.

There are two types of explosions:

1. **High-order Explosives**, which produce blast waves that are supersonic (>1,200 meters per second) pressure waves caused by explosives such as C4, Semtex, trinitrotoluene (TNT), nitroglycerin, dynamite, and ammonium nitrate fuel oil (ANFO); and
2. **Low-order Explosives**, which produce subsonic blast waves, but lack the high pressure of high-order explosives. Examples of low-order explosives include petroleum-based bombs, such as pipe bombs, gun powder, Molotov cocktails, or non-conventional weapons (e.g. like aircrafts improvised as smart bombs).

During an explosion, the blast wave pressure almost instantaneously reaches its maximum velocity of up to 8,000 meters per second, depending on the type of explosive. Blast wind is produced as the expanding gas of the explosion displaces a large volume of air. As the peak pressure decreases, it creates a negative pressure with a “suction effect” that pulls debris back into the site of the explosion.

Explosions occurring in confined spaces, e.g., buildings and buses, cause more serious injury than do open-air bombings. The reflection of the blast waves by rigid objects (e.g., the ground, walls, or metallic materials) causes an increase in power and, therefore, damage.

CATEGORY	CHARACTERISTICS	POTENTIAL TYPES OF INJURIES
Primary	Direct effect of blast wave pressure on body organs and tissues	Blast lung Tympanic membrane rupture Abdominal hemorrhage/perforation Traumatic brain injury Globe (eye), liver, spleen, kidney rupture
Secondary	Victim impacted by propelled objects	Penetrating ballistic or blunt injuries Eye penetration
Tertiary	Victim thrown into air or into other solid objects by blast wind	Traumatic amputation Fractures Brain injury (closed and open)
Quaternary	Pre-existing illnesses exacerbated by blast event; other injuries not due to primary, secondary, tertiary or quaternary effects	Asthma/COPD Myocardial ischemia/infarction Hypertension Burns Crush injuries

Table 14.1: Categories, types, and characteristics of blast injuries (COPD = chronic obstructive pulmonary disease)²³

The amount of damage caused to humans and structures is related to: (1) the amount and composition of the explosive material used; (2) the proximity to the explosion; (3) the delivery system deployed; (4) the presence of any protective barriers or environmental hazards; and (5) associated damages, such as a building collapse or a fire from the explosion.

BLAST INJURIES

Explosions can produce unique patterns of complicated, multi-system injuries. There are four general categories of blast injuries: (1) primary; (2) secondary; (3) tertiary; and (4) quaternary; however, these categories are not mutually exclusive and a victim may suffer blast-related injuries in each of these categories. Table 14.1 lists these blast categories as well as their characteristics and the potential types of injuries they can inflict.

Primary Blast Injury

Causes

Primary blast injuries are caused by the direct effect of the pressure of the blast wave on body organs and tissues. The ensuing damage is caused by three different mechanisms:³

1. *Implosion* — As the shock wave travels through the body, the pressure compresses air-filled structures, e.g., the lungs, the middle ear, and the gastrointestinal tract. After the wave has passed, there is a rapid re-expansion of these compressed structures that damages both the organs and adjacent structures. In effect, these are miniature internal explosions;
2. *Spalling effect* — When the shock wave passes from a high-density organ to a lower-density organ, the associated reverberation can cause molecular disruption; and
3. *Acceleration/deceleration* — Organs and tissues of different densities also cause different rates of shock wave acceleration, resulting in stretching and tearing of the tissues. Additional damage is caused by the sudden shock wave deceleration impact within these organs against other internal surfaces.

Types of Injuries

The body parts most vulnerable to the effects of an explosion are the air-filled interfaces within the body, such as the lungs, bowel, and middle ear. Table 14.2 provides an overview of explosive-related injuries. The main types of primary blast injuries are: (1) blast lung injury; (2) tympanic membrane injury; (3) traumatic brain injury; and (4) other miscellaneous injuries.

Blast Lung Injury (BLI) — Blast lung injury results from the blast's direct effects on the lung causing biochemical and histological changes in that organ. The extent of injury is determined by the peak and duration of the blast wave. One of the highest incidences of recorded blast lung injury occurred in 44% of the total patients injured from two suicide bombings on enclosed public buses in Jerusalem between 25 February and 4 March 1996.⁴

SYSTEM	INJURY OR CONDITION
Auditory	Tympanic membrane rupture, ossicular disruption, cochlear damage, foreign body
Eye, orbit, face	Perforated globe, foreign body, air embolism, fractures
Respiratory	Blast lung, hemothorax, pneumothorax, pulmonary contusion, and hemorrhage, arterio-venous fistulas (potential source of air embolism), airway epithelial damage, aspiration pneumonitis, sepsis

Table 14.2: Overview of explosive-related injuries²⁶

Through both the Spalling effect and implosion, the alveolar membranes of the lung become torn and damaged, and the alveolar-capillary interface is disrupted. The pressure differential between the blood vessels and the air-filled alveoli causes rupture of the alveoli and microvessels with infiltration of blood into the alveolar spaces. Blast lung injury is the most fatal injury associated with explosive events.

Blast lung injuries include: pulmonary contusion, pulmonary edema, air embolism, hemo/pneumothorax, hemo/pneumo-mediastinum, disseminated intravascular coagulation (DIC), and Acute Respiratory Distress Syndrome (ARDS). Victims of blast lung injury may present with acute respiratory failure (apnea, bradycardia, and hypotension) or milder symptoms, including dyspnea, tachypnea, air hunger, cough, hemoptysis, chest pain, or subcutaneous emphysema. Blast lung injury may occur without any external signs of injury to the victim, but should be suspected in all victims involved in an explosion who present with tachypnea, hypoxia, and respiratory distress.⁵ Chest radiography is used to confirm the diagnosis of blast lung injury, to determine the severity of injury to the lung, and to monitor its progression;⁶ blast lung injury may not develop until 24 to 48 hours after the event.⁷ The chest radiograph typically will demonstrate a “butterfly” image; occasionally this image will appear as a “snow storm”.

Tympanic Membrane Injury — The anatomic structure injured most frequently by explosions, and at the lowest pressure blast, is the tympanic membrane of the ear. An increase of pressure of as little as 5 PSI above atmospheric pressure can rupture the human ear drum.⁸ Ear injury from the blast must be suspected with the presence of blood in the external canal, hearing loss, tinnitus, vertigo, or otalgia in patients involved in any explosion.

TYMPANIC MEMBRANE EXAM FOR BLAST PATIENTS

Some clinicians have suggested utilizing portable otoscopes to check all victims involved in a blast event for rupture of the tympanic membranes.⁹ If the tympanic membranes are intact, and other symptoms (e.g., respiratory distress and abdominal pain) are absent, other serious primary blast injuries can be conditionally excluded. Those victims with ruptured tympanic membranes should then have chest radiography and be observed for at least eight hours to rule out other blast injuries.

However, a study of 647 survivors of 11 blast events in Israel between 1994 and 1996 revealed 193 persons who sustained primary blast injuries. Of these, 142 persons (73.5%) sustained isolated ear drum perforation, 51 (26%) experienced other forms of blast injuries, and 18 (9%) had isolated pulmonary blast injury. None of the 142 patients with eardrum perforation developed a blast lung injury, and of the 18 who developed a blast lung injury, none had a tympanic membrane rupture. The results of this study demonstrate a lack of any relationship with eardrum perforation and concealed blast lung injury.¹⁰

Traumatic Brain Injury — A traumatic brain injury (TBI) can result from the blast effects of an explosion. The most common types of brain injury resulting from a blast are axonal injury, contusion, and traumatic subdural he-matoma.¹¹ Victims may experience a mild concussion with only a limited change in consciousness, or severe concussion with a long-term change in consciousness or cognitive abilities, often without physical evidence of head injury. These victims may be agitated and present with symptoms similar to those of a patient with post-traumatic stress disorder (PTSD). It is important to remember that dysfunctional actions of victims of an explosion are not necessarily behavioral; traumatic brain injury should be suspected in all victims with headache or changes in neurological function or behavior following an explosive event.¹² In a study of patients who sustained explosive injuries involving only their lower extremities, neurological symptoms (e.g., headache, vertigo, agitation, insomnia, and poor concentration) were present in 51% of the patients.¹³

Other Injuries — Other injuries that may occur from an explosion include rupture or hemorrhage of solid organs, e.g., the liver, spleen, kidney, and eye. These usually are the result of very high blast forces in confined spaces and with close proximity to the blast center.

Secondary Blast Injury

Secondary blast injuries are caused by bodily impact with primary fragments (i.e., the bomb itself) or secondary fragments (i.e., surrounding materials, such as concrete, glass, or wood), which are impelled by the blast wave and blast wind. These injuries are referred to as ballistic trauma. Next to injuries

resulting from collapsed buildings, penetrating injuries are the leading causes of deaths and injuries resulting from terrorist bomb attacks.¹⁰

In a terrorist attack, the explosive material often is surrounded or embedded with metal objects (such as nails, screws, or spheres), to enhance its damaging capability. These metal objects may be small and produce tiny holes in the victim that are difficult to locate; however, these minute penetrations can cause life-threatening injuries due to the velocity of their impact. Such penetrating, nearly invisible wounds have occurred inside a victim's mouth, and, in one case, a small nail was discovered nestled in the pituitary gland of a 14-year-old girl.¹⁴

In suicide bombings, heavy shrapnel, such as bolts and nuts, replace the lighter nails and nail heads used by terrorists. These elements constitute the heaviest part of the projectile and, thus, will impact first. The vast array of projectiles used causes extensive soft tissue damage due to the combined surface area impacted (Figure 14.1). As these wounds usually are grossly contaminated, it is important to determine the status of the victim's tetanus vaccination protection. Severe contamination also may delay performing primary closure of the wound.

In the case of suicide bombings, the terrorists, themselves, become part of the bomb; that is, their body parts (tissues, bone fragments, etc.) as well as those of other victims, can become flying debris capable of impacting the victims. In addition to the penetrating injuries caused by these projectiles, they carry the risk of transmitting infectious diseases, such as hepatitis and human immunodeficiency virus (HIV).¹⁵

In March 2002, a hotel bombing at a Passover dinner celebration in Ne-



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Figure 14.1: Lower extremity of a young victim of a suicide bomb attack who sustained multiple shrapnel injuries

tanya, Israel resulted in 164 victims being transported to the Netanya Hospital Emergency Department. One of the injured victims arrived with what was originally thought to be an open fracture of the femur. However, after radiological examination, it was determined that the bone protruding from the patient's quadriceps actually belonged to the suicide bomber.

As a result of infection concerns, Israel's Ministry of Health has mandated active immunization against hepatitis B for all victims of suicide bombings. Additionally, consideration should be given for follow-up HIV testing for all surviving bombing victims.

Tertiary Blast Injury

Tertiary blast injuries are caused when the force of the blast throws a victim into other solid objects or into the air. The injuries sustained can include head injuries, fractures, traumatic amputations of long bones, and chest trauma. Generally, a person with tertiary blast injury is fairly close to the location of the explosion.

Quaternary (or Miscellaneous) Blast Injury

Quaternary blast injuries are related to pre-existing illnesses or conditions that may become exacerbated by the blast event, e.g., asthma, myocardial infarction, or pregnancy. Quaternary blast injuries also encompass injuries resulting from the effects of the explosion, e.g., burns or crush injuries from resultant fire or building collapse, chemical or radiation exposure, and inhalation injury or asphyxiation.

Often these types of injuries occur in conjunction with each other. For example, toxic inhalation and burns are common injuries from fires, as cyanide and other toxins often are present. Inhalation injuries often occur with the crush injuries associated with a building collapse, as occurred in the World Trade Center collapse, in which 49% of the injured sustained inhalation injuries.^{16,17}

Crush Injury/Syndrome

Building collapse or other similar results of bombings (e.g., movement of large pieces of debris) can result in the entrapment of victims with crush injuries due to compression or pressure on parts of the body. Crush injury more frequently affects the extremities, but also can affect the torso of the victim(s). When the entrapped body part is relieved after being compressed for a prolonged period, crush syndrome can result from the release of built-up chemicals that produce systemic effects, including lethal arrhythmias, renal failure, hypovolemic shock, and electrolyte disturbances.

Early fluid therapy, even before the victim is extricated, is essential to limiting hypovolemia and shock when the victim's compressed body parts are released from entrapment. Evidence suggests that adding 50 milliequivalents of

sodium bicarbonate to liter bags of normal saline infusions may help to prevent the build-up of myoglobin and uric acid and the resulting obstruction of urine flow.^{18,19}

Patients who develop crush-induced renal failure may require dialysis management if fluid therapy fails to maintain urinary output. A particular challenge in disasters from events such as earthquakes, which typically cause crush injuries, is the ability to provide dialysis effectively. For example, the 1999 Bam earthquake resulted in >600 victims with acute renal failure.¹⁸ With limited electrical availability as a result of the earthquake, peritoneal dialysis may be the only treatment option; however, difficulties arise in performing peritoneal dialysis on patients with torso-related trauma.¹⁸ Hyperkalemia resulting from crush injuries also can be life-threatening and may require treatment with kayexalate, both orally and rectally.

Burn Injuries

Explosions often produce burn injuries as a result of high temperatures, burning fuel and materials, and direct contact with heated objects. Weapons of mass destruction also can cause burn injuries through chemical and radiation exposure. Confined space blasts tend to inflict a higher percent of burn injuries to the blast victims than do open air bombings, chiefly as a result of the concentrated heat of the explosion.²⁰

Some clothing materials can melt and can continue to burn the victim beyond the initial explosion event. Treatment priorities for patients with burn injuries, therefore, begin with carefully removing the patient's clothes to stop the burning process. The next priority, along with immediately addressing life-threatening issues, is assessing the burns and associated injuries to determine the appropriate amount of fluid resuscitation required. Patients with burns involving >20% Total Body Surface Area (TBSA) require that their estimated fluid replacement needs be calculated using one of several different available formulas. The Parkland Fluid Replacement Formula calculates the fluid need of the burn victim for the first 24 hours post-event in the following way: ²¹

$$4 \text{ ml} \times \text{Body Weight (kg)} \times \% \text{ TBSA burned}$$

Half of the total fluid replacement needed should be administered within the first eight hours, with the remaining half administered over the next 16 hours. However, there is a dilemma regarding fluid management in victims with blast lung injury who also suffer burns; generally, fluids are restricted in patients with a blast lung injury, while a burn patient requires aggressive fluid administration. This unique combination of injuries requires careful monitoring of urine output along with invasive monitoring of intravascular volume indicators, such as cen-

tral venous pressure (CVP), to guide correct fluid management.²²

Airway management also is a priority in burn patients, particularly in the presence of inhalation injury. Patients with inhalation injury may present with facial burns, cough, respiratory distress, soot around the mouth or nose, or an inflamed airway. Consideration should be given to early intubation to protect the airway from occlusion secondary to post-inhalation edema.

TREATMENT

As penetrating and blunt trauma are the most commonly noted injuries among victims of explosions, arriving victims should be treated according to standard triage and trauma protocols.²³ Victims with symptoms of blast lung injury as well as those with multiple entry sites and extensive tissue damage should be tended to rapidly. The extent and type of the trauma, along with the incidence of multiple trauma, often require specialty care and, sometimes, the simultaneous involvement of multiple specialty teams (e.g., vascular, surgical, neurosurgical, neurological, orthopedic) in the treatment of one patient.²⁴

Rapid and appropriate triage of blast-injured victims performed by experienced surgeons or emergency physicians can be difficult as only a few seconds are allowed for each triage assessment and decision; lengthier examinations often are necessary to locate potentially life-threatening, penetrating injuries in victims who appear to be stable.²⁵ Particular attention should be given to examination of victims' lungs, abdomen, and tympanic membranes. Additionally, these victims' conditions can change rapidly; frequent re-evaluation of these patients is mandatory.

Plans for patient flow throughout the hospital are essential to prevent a patient backlog, or "bottleneck". A limited number of surgeons and available operating rooms necessitate the postponement of elective surgeries, and only performing surgery on unstable victims, hypotensive victims with abdominal or thoracic injuries, and those at risk for loss of a limb. Both Radiology and Computerized Tomography (CT) departments also are prone to develop bottlenecks; these services should be both prioritized and used as sparingly as possible during the rapid influx of victims with blast injuries. Focused abdominal sonography for trauma (FAST) should be utilized for these patients rather than the time-consuming diagnostic peritoneal lavage assessment.

All patients with suspected blast lung injury should be placed on high-flow oxygen with continuous monitoring of their oxygenation status with a pulse oximeter. Decreasing arterial oxygen saturation levels may be an early indicator of the development of blast lung injury prior to the manifestation of other symptoms.⁹

Air embolism is not an uncommon occurrence in blast victims. Depending on the location of the embolism, it may produce symptoms similar to those of a stroke, myocardial infarction, or central nervous system injury. If the patient

develops an air embolism, hyperbaric treatment may be effective.

Generally, victims from the blast site who are without complaints can be discharged from the hospital after four to six hours of observation.²⁶ Those sustaining tympanic membrane ruptures should undergo chest radiography and remain in the hospital for observation for at least eight hours; tympanic membrane ruptures usually heal within a few months post-event. Patient discharge instructions regarding follow-up audiometry assessment must be written to ensure communication in these hearing-impaired victims.

CONCLUSION

Victims with blast injury require specialized assessment and treatment due to the unique nature of blast injuries. Blast victims have a higher rate of critical injuries and require more specialized care and a greater use of critical care resources than do other trauma victims. Among terrorism-induced incidents, blast events are the leading cause of death and injury.

The preparedness of healthcare facilities to care for blast victims has not reflected the high incidence of blast terrorist events over events involving nuclear, biological, or chemical (NBC) agents. Nursing preparedness involves gaining knowledge in the unique aspects of blasts and blast injuries. Nurses also should advocate for their healthcare facility to properly balance preparedness among likely scenarios and participate in the development of plans for receiving and treating victims of blast injury.

7/7 LONDON BOMBINGS: LESSON LEARNED

The 7 July 2005 London bombings (also known as the 7/7 bombings) were caused by homemade explosive devices packed into backpacks. The bombings killed 56 people (including the four bombers), injured 700 passengers, and disrupted the city's transportation system. Lessons learned from the bombings include:²⁷

1. Prepare for events that involve multiple sites;
2. Prepare for events that damage transportation capabilities;
3. Educate all physicians in blast injury recognition and treatment;
4. In addition to the emergency medical service, it is necessary to train other medical personnel in emergency skills, e.g., triage and extrication; and
5. Planning should include systems to handle the increased communication needs of responders during a large event.

Robert Powers

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CHAPTER 15

DECONTAMINATION

Robert Powers

TRADITIONALLY, HOSPITALS HAVE BEEN unprepared for receiving contaminated victims after an incident involving chemical, biological, or radiation exposure. Although hospital decontamination often is considered a mass-casualty weapons of mass destruction (WMD) event, contamination more frequently involves an individual or a few persons exposed to a contaminant used within the community, typically at the workplace. Often, the response to these small events can tax an unprepared hospital and risk staff exposure. A Canadian study found that only 30% of emergency departments (EDs) had a decontamination area, only 5% had protective respiratory equipment for the staff; and 14% of those with protective respiratory equipment had no decontamination plan.¹ An Australian study revealed that 30% of hospital EDs never had tested their chemical response plan and that Australia had no minimum standard guidelines for hospital decontamination preparedness.² In a hospital in Georgia, the United States, three staff workers developed symptoms of exposure after receiving only one contaminated patient; the patient had not been decontaminated, nor was the appropriate level of personal protective equipment (PPE) worn by the caregivers.³

OBJECTIVES:

- List and explain three reasons for hospital decontamination capability;
- Describe the steps of the decontamination process; and
- Understand the levels and components of the personal protective equipment required for decontamination procedures.

The reasons for such *unpreparedness* include both the lack of equipment and a lack of education and training. However, unpreparedness often hinges on the lack of appreciation of the vital need for decontamination preparedness by hospital leaders and staff. The opinion of many hospital leaders has been that patients either will be decontaminated by field teams at the scene before they

are transported to the hospital, or that contaminated patients will be transported to a specific area hospital with decontamination capabilities. However, research indicates that up to 46% of contaminated victims leave the scene without waiting for field triage or decontamination and go to the nearest hospital, unaware of which area hospital may be designated as the decontamination referral hospital, or of what level of decontamination preparedness exists at the nearest hospital.⁴ Following the sarin attack in Tokyo, Japan, in 1995, local hospitals were inundated with the presentation of 5,500 victims potentially in need of decontamination; the Tokyo Fire Department had not performed decontamination procedures on the scene for any of these victims.⁵

While large-scale WMD events have a relatively limited risk of occurring in a particular community, particularly a rural one, contamination from other causes (e.g., industrial, agricultural, or transportation-related incidents) can occur frequently and seriously impact local hospitals. A study using the US Hazardous Substances Emergency Events Surveillance (HSEES) records of over nine years and within 15 reporting states, found that 92 events occurred resulting in a total of 941 patients in need of decontamination at the hospital.⁶ Another study found that 47% of responding hospitals had received an average of 2.4 contaminated patients during the previous year.⁶ Clearly, these events occur often enough in both rural and urban settings to further emphasize the need for decontamination preparedness of all healthcare facilities.

DECONTAMINATION

Contamination of a victim occurs with his/her exposure to potentially harmful chemical, biological, or radiological materials through inhalation, absorption, injection, or ingestion. The contaminants may be in liquid, solid, or gas form. Persons can be exposed to a contaminant directly or indirectly. *Direct* or *primary contamination* occurs with direct exposure to the contaminant. Under usual circumstances, this does not occur in the hospital setting as the object causing the contamination has been left at the scene; however, in certain circumstances, the source may remain with the patient, e.g., embedded shrapnel from an explosive device with radioactive material. *Indirect* or *secondary contamination* is exposure to an object or person that has been contaminated by the primary source. One source of secondary contamination is through off-gassing, in which the vaporization of residual contaminated liquids on the patient or their clothing continues after removal from the primary source.⁷ Hospital decontamination procedures are intended to eliminate or reduce the risk of secondary contamination to staff.

Decontamination is the removal of contaminants from a person or object through the use of various cleansers or neutralizers. The extent of injury from exposure to contaminants is dependent upon the concentration, quantity, and

duration of contact;⁸ therefore, decontamination procedures to remove the contaminants should be implemented within two to three minutes of exposure to limit the patient's duration of exposure.⁹

Decontamination involves the use of copious amounts of water in a series of washes and rinses to dilute and wash the contamination from the hair and skin of exposed victims. The alternative to this *wet decontamination* process is a *dry decontamination*, which involves removing the victim's clothing and wiping the victim with one of a variety of materials, such as Fuller's earth, flour, dirt, or commercial or military decontamination pads. Dry decontamination is reserved for conditions when no water is available, as an alternative to the use of water in extremely cold climates, and for those rare chemicals for which the use of water may need to be avoided (e.g., white phosphorous).^{7,9,10}

Patients exposed to a gas or vapor require no more than the immediate removal of their clothing; a complete wet decontamination prior to entry to the hospital is not needed as evaporation of any deposited materials occurs quickly.^{10,11} One study found that most moderately or highly toxic substances, when sprayed on a victim, evaporate within five minutes of exposure.¹² If the contaminant is a powder, it should be brushed off the victim prior to undergoing a wet decontamination procedure.

Decontamination procedures sometimes involve the use of a solution (such as a soap, shampoo, or detergent in water) although there is no evidence to support the use of such agents. The use of diluted bleach for patient decontamination is not recommended as the sodium hydrochloride solution carries the risks of corneal abrasions, chemical burns, and significant mucosal irritation.¹³ Additionally, skin abraded by bleach and aggressive scrubbing increases the risk of absorption of the contaminants. However, a dilute bleach solution continues to be recommended for cleaning the equipment used in the decontamination process.¹³

WHY DECONTAMINATE?

The three primary reasons to perform hospital decontamination are to: (1) prevent or limit victim exposure; (2) prevent staff exposure; and (3) preserve hospital services.

Arriving contaminated victims need decontamination to prevent continued exposure to a particular contaminant. The duration of exposure is a key determinant of the level of exposure and the amount of distress experienced by the victim as symptoms continue to develop until decontamination occurs.⁸ Limiting exposure time through effective planning that prevents wait or lag times, as mass numbers of victims await their turn in the decontamination shower, also can serve to improve outcomes.

Hospital staff can become exposed to the contaminant through secondary exposure. During the Tokyo subway sarin attack, 110 staff members at St.

Luke's Hospital developed some signs and symptoms of exposure; in the chapel, an overflow area in which patients were treated, 38 of 83 (45.8%) staff workers became exposed.⁵ However, neither removal of clothing nor decontamination procedures were performed on the arriving victims, nor did the healthcare staff in that area wear appropriate PPE.⁵ A study using US HSEES data from 1992 to 2000 found that in 92 events necessitating decontamination in the hospital, healthcare staff comprised 23% of the total number of victims needing decontamination in rural areas, and 38% in urban areas.⁶ These data demonstrate the risk to healthcare providers of secondary contamination in dealing with arriving contaminated victims and emphasize the need for following appropriate contamination procedures and wearing the correct PPE.

Decontamination also is performed to prevent the hospital from becoming contaminated and potentially shutting down due to the contamination. Decontamination set-up and procedures should be directed toward preventing contaminated victims from entering the hospital prior to decontamination; this prevents the spread of contaminants within the facility and, thus, assists in keeping the facility operational.

HOSPITAL DECONTAMINATION TEAMS

Performing decontamination at the hospital involves establishing and training a decontamination response team that can respond rapidly, assemble the necessary equipment, and carry out the decontamination process of all contaminated victims. Some hospitals have agreements with first-responder agencies (i.e., fire departments) to respond to the hospital's decontamination needs and perform the decontamination procedure; hospital staff receive the victims only after they have been decontaminated. However, dependence on outside agencies to initiate the decontamination process may result in delays in providing care. For example, if the event is large, first responders may be occupied at the scene of the event and may not have spare resources to deploy to the hospital. Also, there may be medical needs of victims within the decontamination zone that require healthcare professionals rather than fire personnel, (e.g., administering antidotes and assisting ventilation).

Most hospitals' decontamination teams consist of hospital staff members that assemble when notified of an event through overhead announcements or paging systems. However, there are several different approaches as to the make-up of these teams. Possible approaches include non-medical teams, combination teams, and Emergency Department (ED) teams.

The *non-medical team* approach is based on the concept that healthcare providers have greatest value outside of the decontamination area and, thus, consists of trained decontamination team members from non-medical or non-clinical hospital staff (e.g., housekeeping or grounds keeping services). One

disadvantage of this approach is that these personnel normally do not have direct patient contact and, consequently, may be hesitant to engage in “hands-on” activities required during the decontamination process.

The *combination team* approach is based on the recognition of the need to have at least some healthcare providers within the decontamination area and, thus, is a team composed of members from both medical and non-medical hospital staff.

The *ED team* approach uses trained ED staff members for the decontamination team; it is based on a misdirected viewpoint that decontamination is an ED issue and that the ED alone should be responsible for the response. The primary disadvantage of this approach is that if a large number of ED staff are involved in activities within the decontamination zone, the ED is depleted of the staff needed to care for patients after they have undergone decontamination.

Decontamination Team Recommendations

Due to inherent delays in activating and assembling the hospital-based decontamination team, the ED staff must be able to begin decontamination procedures (whether or not they are considered part of the official hospital decontamination team) while awaiting reinforcement by the decontamination team members from other departments. Incoming decontamination team members should replace the ED staff promptly, allowing them to return to needed disaster care roles within the ED. A decontamination team that is composed of both medical and non-medical team members prevents the diversion of an excessive number of healthcare providers to the decontamination zone at a time when the healthcare staff is stretched to fill all of the other needed disaster response roles. Such an approach utilizes non-medical people who otherwise would not have a role in disaster response.

There has been some debate over the role of the physician within the decontamination zone, and whether or not his/her inclusion is an appropriate use of resources. Treatment protocols (such as the guidelines for nerve agent antidote administration discussed in Chapter 11) allow nursing staff to administer necessary treatments under emergent circumstances without the immediate oversight of a physician. Additionally, the inherent, limited dexterity and visual field associated with wearing the bulky chemical protection suit and respirator in the decontamination zone decrease the healthcare providers' ability to perform advanced patient care. Thus, advanced patient care is best performed post-decontamination by nurses following established protocols, freeing ED physicians to coordinate triage or patient care within the ED, particularly in the early stages of a surge of patients arriving at the hospital.

TRAINING

Within the United States, the Occupational Safety and Health Administration (OSHA) has developed guidelines regarding the required education and training for hospital workers who will be expected to work within the decontamination zone or who might come into contact with contaminated victims arriving at the hospital before decontamination has been performed. The OSHA classifies hospital decontamination team workers as “*first receivers*” to differentiate them from the field agency staff, often referred to as first responders. The OSHA’s “Best Practices for Hospital-based First Receivers” document (available at www.osha.gov/dts/osta/bestpractices/firstreceivers_hospital.pdf) is an excellent resource that provides guidance on training standards and many other hospital decontamination issues. The following OSHA guidelines related to training competencies and standards are required for US hospitals, but also provide guidance for hospitals outside of the United States in developing decontamination training.

According to the OSHA guidelines, core education and training components for hospital workers involved in decontamination operations should include: (1) understanding the hospital’s Emergency Operations Plan and their roles within the response; (2) site safety, including risks to receiving personnel; (3) appropriate selection and use of PPE; and (4) decontamination procedures.¹¹

The OSHA utilizes its Hazardous Waste Operations and Emergency Response Standard guidelines developed for field-based first responders, and applies these guidelines to hospital personnel. It requires its First Responder Operations Level education and training for all hospital employees (including security staff) who may be working within the decontamination zone, although the emphasis of the training for first receivers differs from that for field-based first responders. The OSHA recommends at least eight hours of training for hospital decontamination zone staff workers or, in cases in which the worker has had previous experience, a demonstration of competency.¹¹

The OSHA also requires First Responder Awareness Level education and training for hospital staff who might be the first to have contact with an unannounced, arriving contaminated victim (e.g., registration clerks or security guards). There is no required length of time for the First Responder Awareness Level training, but certain competencies are required to be covered in the course content.¹¹ These include:

- An understanding of what hazardous substances are, and the risks associated with them during an incident;
- An understanding of the potential outcomes associated with an emergency created when hazardous substances are present;
- The ability to recognize the presence of hazardous substances in an emergency;

- The ability to identify the hazardous substances, if possible;
- An understanding of the individual's role in the employer's Emergency Response Plan, including site security and control; and
- The ability to realize the need for additional resources, and to make appropriate notifications to the communications center.¹⁴

Both levels of training require annual refresher training, although the OSHA stipulates no specific time length for the refresher program. However, the hospital must ensure that the training maintains individual competence skills and must maintain records regarding the means by which competence was determined.

The OSHA designates that Operations Level education and training, i.e., the training necessary for hospital workers with roles within the decontamination zone, should include all of the above Awareness Level competencies, as well as the following additional competencies:^{11,14}

- The ability to perform basic hazard and risk assessment techniques;
- The ability to select and use proper PPE provided to the first responder at the operational level;
- An understanding of basic hazardous materials terms;
- The ability to perform basic control, containment, and/or confinement operations within the capabilities of the resources and PPE available;
- The ability to implement basic decontamination procedures; and
- An understanding of relevant standard operating procedures and decontamination termination procedures.

The OSHA has three other designated training levels for field first responders (technician, specialist, and incident commander) that have additional competencies relevant to hospital decontamination training. These competencies are directed toward those team members designated by the hospital administration to establish and lead the entire decontamination operation. These competencies may be included in the general training provided to all decontamination team members, or reserved only for those members with leadership roles within the team. These additional competencies include:¹⁴

- The ability to implement the hospital's Emergency Response Plan;
- The ability to function within an assigned role in the Incident Command System;
- An understanding of advanced hazard and risk assessment techniques;
- The ability to perform advanced control, containment, and/or confinement operations within the capabilities of the resources and PPE available; and
- An understanding of basic chemical and toxicological terminology and behavior.

DECONTAMINATION PROCESS

Activation

Hospital notification that a contamination event has occurred within the community may be received via ambulance crews, fire department crews, or via communication with a public health or infection control nurse. In a sudden, mass-casualty event, this will impact the ED directly, as this is where the victims will go for care; in a very large event, some victims may seek care at physician offices and community clinics.

The most important aspect of decontamination is that, whatever method is used, the removal of contamination occurs promptly after exposure.¹⁵ Hospital staff must be able to implement some level of basic decontamination almost immediately as victims will begin to arrive within five to 20 minutes after the event, allowing little time for assembly of large-scale decontamination equipment and the decontamination team. The decontamination process should be operational within two to three minutes of team activation.⁹

A scalable approach incorporating such measures as the use of an established decontamination room, permanently fixed decontamination showers, or simple garden hoses can facilitate rapid implementation and can be undertaken quickly by ED staff without outside assistance. This approach can eliminate delays in the decontamination of the initial victims in need of decontamination, as it allows decontamination to begin without having to wait for large equipment to be assembled or decontamination team members to arrive from home or various departments of the hospital. As the event continues or as the number of presenting victims escalates, the arriving decontamination team can establish the large decontamination shower systems while the smaller scale efforts continue. When both the decontamination team and the large showers become fully operational, the initial ED staff operating the small system can return to their respective roles within the ED. However, this approach requires two essential preparedness components: (1) staff members tasked with establishing these quick response decontamination systems must be trained to the competencies required of the Operations Level of training, as listed previously, including hands-on practice in making the system operational; and (2) staff members who are likely to be the first to receive a contaminated victim must know how to determine if the person is in need of decontamination. Individuals needing rapid decontamination include those presenting with: (1) signs and symptoms of an exposure; (2) some evidence of contamination on clothing or skin; and (3) a clear history of being in close proximity to an exposure-producing event.¹⁶

Chemical exposures typically result in the early appearance of symptoms, causing victims to present to the healthcare facility soon after exposure; chemical-

ly exposed victims require immediate decontamination. Victims exposed to biological agents typically do not need to undergo decontamination procedures as their symptoms develop slowly over days or weeks, by which time the victims will have showered and changed clothes several times before arrival at the hospital i.e., they already will have effectively decontaminated themselves before arriving at the hospital.¹⁷ However, in circumstances in which there is an obvious recent exposure, such as the presence of anthrax powder on clothing or an announcement from terrorists that victims have just been exposed to a particular agent, victims may present to the healthcare facility rapidly and in mass, and may need immediate decontamination based on the agent to which they were exposed.

The response to victims of radiation exposure differs from that of chemical events in that the risks associated with radiation are deemed low and, thus, providing care for life-threatening injuries always takes precedence over decontamination. Even though these patients may be radiologically contaminated, they can enter the hospital for care of life-threatening injuries first, without undergoing decontamination.¹⁸ However, patient management still incorporates procedures to limit any risk to the staff or the facility. (See Chapter 13.)

Those victims who present without signs and symptoms of exposure and without a clear history of being near an actual event constitute the group referred to as the “worried well”, as they arrive at the hospital worried about a possible exposure. After the sarin subway attack in Tokyo, 80% of the arriving victims were non-symptomatic.⁵ This occurrence can slow the decontamination process dramatically if effective pre-decontamination triage is not in place. Thus, pre-decontamination triage must be performed immediately upon patient arrival to sort out both the most critical individuals from the “worried well”. Although the “worried well” will need assistance (e.g., counseling), they should be triaged to a holding area or discharge point away from those victims needing immediate decontamination. Based on the magnitude of the event and local protocols, the “worried well” individuals may or may not receive decontamination later, after the clearly contaminated victims have completed decontamination.

Set-up Procedures

The decontamination zone should be established outside of the hospital and is the designated area for the removal and containment of the contaminants from victims prior to their entry into the hospital building. Decontamination zones should be set up with some type of barricade (e.g., traffic cones or barricade tape), that clearly identifies the perimeter of the area. Victims are directed to the decontamination zone entry point through clear and obvious signage and are prevented entry into the hospital at other points using hospital lockdown procedures with all doors locked and guarded by security personnel. The purpose of the decontamination zone is to isolate all contami-

nants by removing the victims' clothing and by washing the victims to contain the contamination within the perimeters of the zone, and prevent the contaminants from spreading any farther on hospital grounds.

The overall decontamination area is divided into three stages or zones: (1) the *hot zone*; (2) the *warm zone*; and (3) the *cold zone* (Figure 15.1).

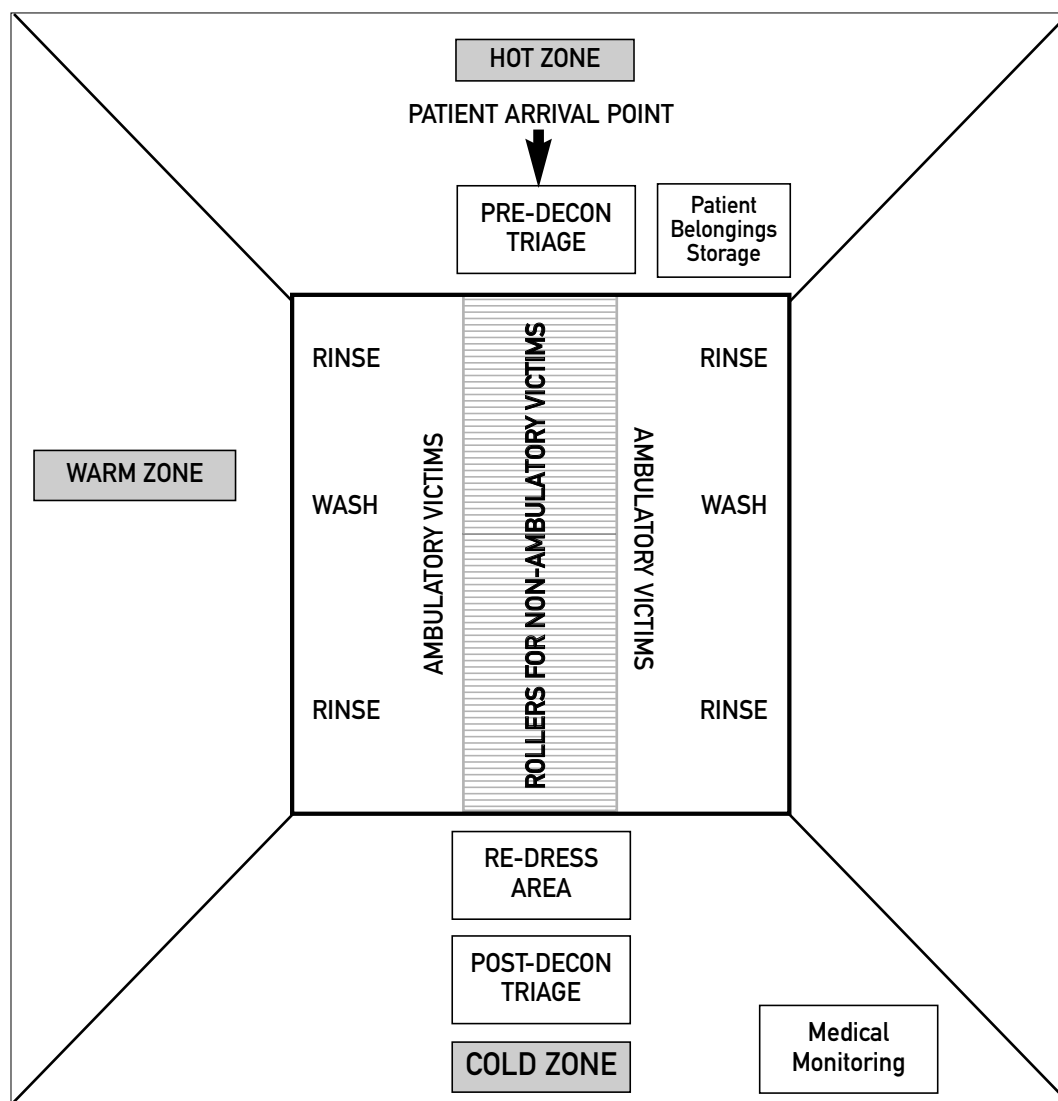


Figure 15.1: Decontamination zones and process

Hot Zone

The *hot zone* defines the initial healthcare system entry point for contaminated victims. The contamination on clothing and personal belongings makes this zone have the highest level of contamination and, thus, is the

hottest area, simply, the *hot zone*. As victims arrive, they are triaged to determine their need for decontamination and their clinical acuity to determine their priority in the de-contamination process. At this point, victims can be directed into showers that separate male and female or ambulatory and non-ambulatory groups. Prior to showering, the victim's clothing and personal belongings are placed into collection bags or hazardous waste bins; these items remain within the hot zone until a decision is reached by local emergency management officials regarding washing them, or returning them, or until law enforcement takes possession of them in a criminal event (i.e., terrorism). As clothing may contain up to 75–90% of the contaminant, removing it from the victims should be an immediate priority.⁹ If victims are unwilling to completely undress, it is acceptable to have them disrobe to the level of their undergarments.¹⁵

The hot zone should be located both upwind and downgrade of the cold zone, in order to help contain contamination.

Warm Zone

The *warm zone* defines the area in which unclothed victims begin showering in a rinse-wash-rinse sequence for a minimum of five minutes, and up to eight minutes if the contaminant is unknown or persistent.¹⁹ Ambulatory victims can perform this process themselves with guidance from a member of the decontamination team. Although there are no data to support this practice, most decontamination centers perform a rinse-wash-rinse process that consists of the following:

Rinse — A head-to-toe, back-to-front shower with water only;

Wash — A gentle scrub, possibly with a cleanser, such as a shampoo or soap. Brushes are not recommended due to the potential for abrading the skin and causing a greater absorption of the chemical. Bleach no longer is recommended as a cleansing agent for victims in mass decontamination.¹⁵ Even the value of using soap or shampoo over a simple rinse using water has been debated.²⁰

Rinse — A head-to-toe, back-to-front shower with water to rinse off the cleansing agent.

Throughout the decontamination process, decontamination team members should supervise the procedure to ensure that victims focus on washing areas that are more apt to have been exposed (e.g., hair, face, neck, and arms) as well as areas where contaminants may settle during a shower, (e.g., armpits, groin, and feet). Non-ambulatory victims must be washed by decontamination team members, moving the victims through the shower either on rollers or on stretchers, taking care to ensure that the patient is washed in all the areas mentioned. This involves turning the victims over to thoroughly wash and rinse their back, where contaminants settle on a supine person.

Cold Zone

The *cold zone*, or *post-decontamination zone*, is considered to be uncontaminated or clean, in that all contaminants have been left behind in the hot and warm zones. Victims coming out of the warm zone showers may towel dry within the warm zone or wait to towel dry until they reach the cold zone. The towel used for drying should be left behind in whichever zone it is used, and not carried to the next zone. However, victims should not put on any gown or other clothing until they are in the cold zone. This requires having a supply of appropriately color-coded gowns in the cold zone for the decontaminated victims to wear after towel drying. Any contamination-detection equipment that hospital staff utilize also may be located within the cold zone. This includes instruments for liquid, vapor, or radiological detection.

Personal Protective Equipment (PPE)

Hospital personnel working within the decontamination zones or working in areas in which they are likely to come in contact with arriving contaminated patients must wear the appropriate type of personal protective equipment (PPE) that will provide them with adequate protection from the particular contaminants of the event. This PPE ensemble must include respiratory, eye, and skin protection to adequately safeguard hospital staff from the risks of exposure.



Photo courtesy of Chief A.C. Rich

Figure 15.2: Firefighters wearing Level-B protective equipment decontaminate fellow firefighters who are wearing Level-A protective suits



Photo courtesy of Chief A.C. Rich

Figure 15.3: Decontamination exercise with hospital first receivers wearing Level-C protection (Note filter respirator units)

The US Environmental Protection Agency (EPA) has established four levels of PPE. Although the terminology describing these levels has been developed by the US EPA, the levels of designation have been adopted as the standard throughout many parts of the world. These levels of protection rank from A through D and range from equipment providing the most protective capability to equipment that offers a minimal amount of protection.²¹

Level A

Is the highest level of protection available and consists of a fully encapsulated, vapor-, water-, and chemical-resistant suit with integrated hood, boots, and gloves. Within the suit is a positive pressure, self-contained breathing apparatus (SCBA) (i.e., air tank). Level A protection equipment is required by field HazMat Teams as they enter a toxic environment in which contamination exceeds the Immediately Dangerous to Life and Health (IDLH) level (Figure 15.2).

Level B

Protective equipment in Level B is less than that of Level A and consists of splash- and chemical-resistant clothing with separate gloves, boots, and facemask. Respiratory protection includes either a positive pressure, SCBA tank (as in Level A) or an oxygen hose line that runs from a protected source of oxygen (e.g., large cylinder) to the HazMat team worker.

Level C

Level C equipment utilizes an Air-Purifying Respirator (APR) that filters the air rather than providing oxygen from an outside source, as in Level A and Level B. The APR uses a hood rather than a mask; the hood offers the benefit of reducing the risk of contamination around the mask and bypasses the need for fit tests to ensure a proper fit.²¹ The Level C chemical suit is chemical- and splash-resistant, but the material often is lighter than that in Level B, providing the worker greater mobility but with less protection from chemical permeation and penetration (Figure 15.3).

Level D

Level D refers to protection provided by standard work clothes. The use of water-repellant gowns, gloves, faceshields, surgical caps, and boots fall into this category of minimal protection.

Level-C protection is the recommended PPE for chemical incident responses by hospital-based decontamination teams.^{9,11} Previously, the use of Level-C PPE was recommended only when the chemical agent was known and the air concentration of the chemical had been determined, e.g., at a hazardous material spill site when on-scene fire department air and liquid analysis determine that there is only a low level of a non-life-threatening chemical. The OSHA does stipulate that Level-C PPE only provides adequate protection when the following conditions exist:¹¹

- The lapse between the time of exposure and the victim's arrival at the hospital exceeds 10 minutes, after which the contaminant has dissipated;
- The victim's contaminated clothing and personal belongings are removed promptly and contained; and
- The hospital, itself, is not the site of the contaminant spill or release.

ITEM	CHEMICAL INCIDENT PPE ENSEMBLE	BIOLOGICAL OR RADIOLOGICAL INCIDENT PPE ENSEMBLE
Respirator	APR	N-95 mask
Outer Garment	Level-C chemical suit	Surgical gown/cap
Gloves	Inner: Nitrile examination gloves Outer: Nitrile or butyl rubber gloves	Inner: Standard examination gloves Outer: Standard sterile gloves
Boots	Chemical boots	Plastic shoe or boot covers
Tape	Chemical or duct tape	Duct tape

Table 15.1: Comparison of items in PPE ensembles for chemical incidents versus biological or radiological incidents (APR = air-purifying respirator)

Within the United States, some hospitals have Level-B PPE equipment; however, most PPE was purchased when OSHA still was unclear about its endorsement of Level-C PPE for hospital use. The UK National Health Service's (NHS) standard PPE for hospital use is consistent with Level-C protection with a powered, air-purifying respirator.²² In Hong Kong, the Hospital Authority adopted the Level-C PPE for use by hospital decontamination teams.²³ Within Australia, Victoria's Department of Human Services recommends that Level-C PPE be used by personnel in hospital receiving roles.²⁴

Appropriate PPE for radiological and biological events differs from that of chemical events. Table 15.1 provides a comparison of all the components required of the different ensembles used for protection from contamination. In events with uncertain or mixed agents, the preference is to wear the highest level of protection, i.e., Level-C PPE, thereby ensuring a broad spectrum of coverage.

Decontamination Team

Incident Commander

An Incident Commander position should be implemented within the decontamination team to ensure an effective and coordinated decontamination response. The Incident Commander position for the decontamination team (also known as HazMat Victim Decontamination Unit Leader) should be assumed by the most senior decontamination team member immediately available.²⁵ The responsibilities of this command position include: ²⁵

- Oversight of the entire decontamination operation;
- Assembling and role assigning of decontamination team members;
- Ensuring proper decontamination measures are implemented rapidly;
- Coordinating with the hospital's Emergency Operations Center or overall hospital Incident Command;
- Troubleshooting problems as they arise; and
- Ensuring the safety of the work environment within and around the decontamination zone.

Other positions and responsibilities within the decontamination team include:²⁶

Decontamination Logistics Manager — oversees team members assigned to the logistics role and is responsible for coordinating the assembly and distribution of the equipment throughout the operation;

Medical Monitoring Manager — oversees the medical monitoring of the health and safety status of the team members during the decontamination operation;

Decontamination Triage Manager — ensures that necessary triage is being performed and that sufficient staff is on hand to prevent "bottlenecks" of arriving victims; also ensures that immediate medical care is being administered as necessary;

Zone Managers — oversee the decontamination personnel and procedures within their individual zone with one manager assigned to each of the zones of the decontamination operation (i.e., hot zone, warm zone, and cold zone);

Strike Team Manager — oversees the decontamination strike team members tasked with bringing non-ambulatory victims from other areas to the decontamination area;

Decontamination Security Manager — oversees security within the decontamination zone to ensure that directions are followed appropriately and manages all collected patient belongings and valuables, particularly if the incident is a criminal act and these items are classified as evidence; and

Screening Positions — consist of decontamination team members posted at every ED entrance to screen arriving victims (i.e., determine if arriving victims are from the contamination event or are in need of health care unrelated to the contamination event (such a cardiac event).

The assignment of each of these positions will vary based on the needs of the event and the numbers of available team members. In events that are small in nature, positions can be combined or implemented gradually as an event becomes progressively larger. For example, an ED that receives one non-ambulatory, contaminated victim could utilize two staff members wearing PPE to decontaminate the victim within the hospital's established decontamination room, while a third staff member serves as the unit leader/medical monitor and oversees the operation from outside the decontamination room.

DECONTAMINATION ISSUES

Decontamination Triage

Decontamination triage is performed at two times: once prior to decontamination and, again, post-decontamination. *Pre-decontamination triage* is done immediately upon arrival of the victims to sort out the “worried well”, who don't need decontamination, from those who do. Small contamination events that produce limited numbers of victims may not require this pre-decontamination triage, as it may be feasible to wash all arriving victims. However, sudden large-impact events (e.g., those involving chemicals or explosives) can result in a deluge of victims that may be as high as 200/hour during the first 60–90 minutes after the event.²⁷ When the number of contaminated victims presenting to the hospital exceeds the immediate decontamination capability of the hospital, pre-decontamination triage should be implemented.

Pre-decontamination triage differs from the usual triage performed by the ED nurse; it consists of a quick determination of the presence of any signs or symptoms of exposure and a question to determine the victim's proximity to an event, such as “Were you at the convention center (i.e., the site of the con-

taminant release)?” A person without signs of exposure and who answers “No” to the above question can bypass decontamination and proceed to a green tag (walking wounded) receiving area.

Post-decontamination triage is performed in the cold zone on patients who have undergone the decontamination process. Post-decontamination triage utilizes a standard triage system. (See Chapter 5.)

Contamination Analysis

A variety of products are available to determine the presence and identity of a contaminant. Although some fire department hazardous material teams have a gas chromatograph and mass spectrometer for field chemical analyses, the cost and training required to use this equipment make them prohibitive for most individual hospital use. Handheld air monitors capable of analyzing many types of weapons of mass destruction agents are available in some hospitals, but the cost of these monitors can exceed US \$20,000. Of more practical value for hospitals are commercially available chemical detection papers or badges developed by the military; some are capable of both liquid and vapor detection. Ideally, these chemical detection papers can be used to swab patients either pre-decontamination, to check for the presence of contaminants, or post-decontamination, to verify the effectiveness of the decontamination process.

Some detection devices currently available for the detection of biological agents have limited ability and are expensive. The detection of biological agents requires much higher sensitivity than chemical detection devices; spectrometry cannot detect or identify biological agents.²⁸ During a suspected radiation event, survey meters (Geiger counters) should be used by decontamination personnel. (See Chapter 13.)

Medical Monitoring

A designated medical monitoring area, typically located behind the cold zone to facilitate movement of staff, is the area that serves as a rest and rehydration point for decontamination team members. This area is staffed by assigned decontamination team members who assist other team members into and out of the PPE, maintain a record of attired team members including their vital signs, duration of time in and out of the PPE and the decontamination zone, and any medical observations. This record also provides for staff accountability and can be used to ensure timely rotation of team members. Staff working in full PPE generally need to be relieved and provided with a period of rest after about 20 minutes of working in the suits. However, a number of variabilities (e.g., the temperature, the physical conditioning of the staff member, and the level of work they are performing) necessitate adjustments in work times based on the assessments and observations by monitoring staff.

Inclement Weather

Extremes in temperature, both cold and hot, can lead to decontamination complications for staff and patients. In a cold weather decontamination study, the US Army Soldier Biological and Chemical Command reported that, regardless of the outdoor temperature, victims exposed to life-threatening contaminants should be disrobed, decontaminated, and then sheltered.²⁹

The following are general recommendations for decontamination in cold temperature conditions:²⁹

- Allow victims to get wet gradually rather than be deluged suddenly with cold water;
- Use warm water whenever possible (e.g., use a portable water heating unit);
- Use heated indoor enclosures, if possible (e.g., indoor showers, indoor swimming pool);
- Consider performing dry decontamination only (i.e., remove clothing and blot the patient with flour, sand, or dirt);
- Place blankets and wraps on patients as quickly as possible post-decontamination;
- Prioritize the decontamination of children, the elderly, and other vulnerable populations to the extent possible;
- Consider the use of brine solutions, granular salt, or other de-icing solutions to prevent ice build-up on the shower floor from the decontamination water; and
- Ensure careful monitoring of decontamination team members and provide frequent rest periods to allow them to warm their face and extremities.

Even in relatively mild ambient temperature conditions, there is the potential for decontamination team members wearing PPE to become overheated and dehydrated. In hot weather conditions, it is important to:

- Monitor decontamination team members closely;
- Rehydrate frequently;
- Rotate team members between work periods and rest periods frequently; and
- Ensure that the rest area provides cooling (e.g., misting fans, shaded area).

Hospital Contamination

Measures to keep contaminated victims from entering the facility include hospital lockdown and the performance of early triage outside of the hospital doors; however, these measures are contingent on the hospital receiving an alert from first responders that an event has occurred prior to receiving any contam-

inated victims. Should the facility become contaminated, or if there is the strong possibility that the hospital has become contaminated, the suspected area of contamination must be isolated to contain any contamination and prevent further spread or exposure. Based on the hospital's capabilities, outside resources, e.g., a fire department Hazardous Material Team, may need to become involved to perform air sampling and liquid analysis to determine if contamination is present and, if so, what measures must be performed to remove the contaminants in order that the hospital can become fully operational.⁹

Privacy

Although fire departments previously have performed decontamination in the field with little consideration for victim privacy, the occurrence of several lawsuits has highlighted the need to shield victims from public view and to segregate them by gender during the disrobing and showering process.^{9,30} Hospitals should provide measures to protect the victims' privacy, including considerations for shielding them from the media.³¹ Privacy can be provided through the use of hanging sheets, tents, and portable or pre-installed curtains.

Pediatrics

Pediatric victims in need of decontamination present a number of distinct issues to address during planning. Children, first of all, may respond in widely different ways to the stress of the event, as well as to the decontamination process. As Freyberg *et al* note, children "have the potential to frolic or panic and/or become immobile in the shower."³² Children also are at increased risk during contamination events and decontamination processes because, in comparison to adults, they have a higher respiratory exchange rate, increased skin permeability, proportionately higher body surface area, and are short in stature, which places them closer to the ground level where gas concentration levels are highest.^{33,34} General key planning issues related to the decontamination of children include:

Staffing and Patient Flow — Plan for more time and more team members to assist in the decontamination of children than for adults, as children may not be cooperative with the attempts to disrobe them. Parents should not be separated from their children, if at all possible during decontamination, but, as they also are attempting to care for themselves, they will need assistance with their children. Unaccompanied children should have a dedicated staff member, such as a child life specialist, who moves with them throughout the decontamination process.³² Whenever possible, dedicated staff members should be the same sex as the child to further limit the child's hesitancy to disrobe;³²

Water Adjustments — Utilize low-pressure, high-volume water flow using warm water. The water pressure recommendation is less than 60 PSI.²⁶ This low pressure can be accomplished through the use of garden-hoses and hand-

sprayers. Additionally, the water temperature should not be <98° Fahrenheit (36.7° Celsius) to help limit hypothermia.²⁶ Portable water heaters can help adjust the water temperature;

Process Adjustments — Do not carry infants or small children into the showers due to the risk of dropping the wet child; use stretchers or alternatives such as infant carriers or infant car seats. Provide rapid drying and warming and have isolettes and radiant warmers available post-decontamination; and

Tracking — Patient tracking should be introduced prior to decontamination to ensure that children remain correctly matched with their parents or caregivers. Utilize two wristbands (one for the parent and one for the child) with a common number or some other system to indicate which child belongs with which adult. Additionally, digital photographs can be taken, particularly in events in which there are unaccompanied children.

All hospitals should be prepared to receive pediatric patients as well as adult patients in need of decontamination. Additionally, even children's hospitals should be prepared to receive adult patients, as victims proceed to the closest hospital, often irrespective of the hospital's particular specialty.^{4,35}

Recovery/Waste Management

Waste Water Containment

Waste water from the decontamination process has the potential to contain low levels of contaminants. Run-off from decontamination operations that is not contained eventually will enter the sewer system or the water table, even though the volume of water used tends to substantially dilute any residual contaminant. The Department of Mechanical and Fluid Engineering at Leeds University (UK) determined that a chemical diluted with water approximately 2,000:1 significantly reduces the potential for pollution.³⁶

However, despite the dilutional effect, hospital plans should include some type of waste water containment measures. Some equipment available to prevent waste water run-off include bladders, berms, and pools. Based on the size and the suddenness of the event, as well as the preparedness level of the hospital, insufficient measures may be in place in time to contain all the waste water from a decontamination operation. Clearly, caring for arriving victims by rapidly removing contamination before further injury occurs supercedes environmental concerns. The US EPA noted in a 2005 position paper that, during a decontamination response, "once any imminent threats to human health and life are addressed, first responders should immediately take all reasonable efforts to contain the contamination and avoid or mitigate environmental consequences."³⁷ Local health management authorities should assist in determinations regarding any contained waste water, i.e., whether to hire a

vendor to pump out the collected water and dispose of it, or to simply discard the collected waste if analysis indicates no hazard.

Solid Waste Management

Solid waste is generated in a decontamination operation by the collection of contaminated personal belongings from victims, and from the materials used within the decontamination zone, e.g., the chemical suits and materials used for showering patients. All items brought into the decontamination zone either must be destroyed or cleaned to prevent any potential contamination.

Based on the event, victims' belongings may be considered evidence, and may need to be handled by the investigating law enforcement office. If the incident is not considered to be criminal, key officials and local businesses, i.e., local emergency management and local waste disposal vendors, can help to determine what, if any, cleaning is necessary to allow victims' belongings to be returned, or if the items need to be destroyed. Local authorities also can provide guidance regarding the proper management of the "soft goods" (i.e., chemical suits and respirator filters) utilized during the decontamination process.

DECONTAMINATION AT INDIANA HOSPITAL

In Indiana, United States, 27 people were taken to the hospital after being exposed to a release of hydrochloric acid vapor. The victims' symptoms included chest tightness, wheezing, nausea, and vomiting. ED staff became aware of smelling fumes from the victims' clothing (i.e., "off-gassing") and some of the staff became symptomatic. The victims subsequently were removed from the ED and outside decontamination was then performed on all victims. Three patients required admission for breathing problems; no staff members were hospitalized.³⁸

CONCLUSION

Persons exposed to a contaminant will not always wait to undergo decontamination procedures at the scene of an event, or have the ability to determine which hospitals are properly prepared to handle contaminated victims. Rather, they will present themselves to the healthcare facility that is closest or that is most accessible to them. Such victims may have been exposed to a contaminant from a local workplace incident, such as an industrial or agricultural accident, or from a terrorist event involving weapons of mass destruction. Hospitals must be prepared for dealing with contaminated adults and children from chemical, biological, and radiation events.

Hospital decontamination preparedness includes the ability to initiate decontamination almost immediately, the ability to rapidly assemble a team of

staff members appropriately trained and practiced in the decontamination process and PPE use, and plans to prevent the hospital facility, itself, from becoming contaminated. Hospital staff and leaders must understand the importance of this preparedness as a necessary capability to help ensure the welfare of the community during an event involving contamination.

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CHAPTER 16

POPULATIONS WITH VULNERABILITIES AND SPECIAL NEEDS

Kelly Burkholder-Allen

WITHIN POPULATIONS there are individuals and groups that are particularly vulnerable to the adverse affects of emergencies and disasters. On a daily basis, nurses interact with individuals and families struggling to maintain a precarious functional balance. Their healthcare deficits, functional deficits, and economic and social challenges result in needs that require careful attention and management by a large continuum of healthcare and social service providers. To that end, nurses can appreciate fully the fact that disaster and emergency preparedness, planning, and services for individuals and groups with identified vulnerabilities and specialized needs have lacked substantive efforts.

OBJECTIVES:

- Describe the benefits and difficulties associated with Special Needs Registries;
- Describe the various health conditions and limitations that increase the vulnerability of the elderly during disasters;
- Understand the accessibility requirements for managing vulnerable groups during the various aspects of a disaster; and
- Describe the resources needed to assist with identifying and locating individuals and groups with vulnerabilities and specialized needs.

LESSONS LEARNED

During Hurricanes Katrina and Rita in the United States, and the Southeast Asia tsunami, the media highlighted the plight of the poor, the elderly, the very young, the disabled, and many other groups of individuals considered to be “at risk” and vulnerable. Their vulnerabilities stemmed from a wide range of disability- and age-specific issues, health-related issues, social issues, and demographic characteristics. Disturbing images from New Orleans, the United States, of

wheelchair bound individuals stuck on an overpass, young children being carried through the rising water, and elderly people stranded for days on rooftops while awaiting rescue were televised repeatedly in the United States. The international media captured the plight of the poor, the elderly, and surviving children, as they clung to wreckage or wandered from hospitals to makeshift morgues searching for surviving loved ones. Prior to Hurricane Katrina, many disadvantaged people lacked transportation and financial resources to evacuate safely, and thus, were forced to seek refuge in their “shelter of last resort”, the Superdome facility in New Orleans. In Indonesia, villages lacked early warning, hazard communication, and adequate disaster preparedness for the tsunami. However, many of the graphic and disturbing images portrayed in the media following the tsunami actually were replays from previous disasters.¹

The effects of Hurricane Andrew in Florida, the United States in 1992 provided evidence that neither individuals with disabilities or health conditions, nor local emergency planners had plans in place for prolonged survival without telephones, essential utilities, or durable medical equipment. After the 1997 flood in Grand Forks, North Dakota, the United States, locating temporary housing that was accessible for wheelchair users presented major challenges. During the wildfires in California, in the United States, in 2003 the lack of closed captioning of news reports prevented people with hearing impairments from fully understanding the level of danger. Unfortunately, these and other valuable lessons learned from previous disasters have not been incorporated universally into current emergency management plans (EMPs) and, consequently, have failed to benefit vulnerable populations.^{2,3}

IDENTIFYING AND REGISTERING NEEDS

For numerous reasons (including privacy, maintaining independence, fear of bias, and a variety of other social and cultural rationale) the elderly, people with disabilities, people with health conditions causing limitations, and numerous other at-risk groups have chosen, in the past, not to identify their needs for assistance; often, this has been to their own detriment.⁴ Prior to Hurricane Andrew, individuals who were dependent upon outreach networks, specialized services, utility-dependent medical devices, and complicated medical and pharmaceutical regimens, frequently did not self-identify, resulting in many unmet needs. These unmet needs often led to the exacerbation of pre-existing conditions and compromised health status. During the first World Trade Center bombing in New York City in 1993, employees and visitors with visual, hearing, and mobility impairments, as well as other health conditions, encountered problems regarding evacuation from the high-rise building.

To facilitate the identification and recording of these needs, Special Needs Registries (SNRs) have been developed in many communities. These SNRs

identify individuals within a community who would be particularly vulnerable in disasters or times of crisis. Enrollment in SNRs provides vital information for the local EMS and other first responders, by identifying geographic locations and clusters of vulnerable individuals. Emergency planners establish the parameters for their registries based on their Hazards and Vulnerability Analysis, and are able to extract specific information on individual/group transportation, evacuation, sheltering, and healthcare needs of this vulnerable group, and, thus, are able to plan accordingly. Enrollees benefit from the enhanced mitigation, planning, response, and recovery efforts as well as the enhanced and accessible communication linkages.

The success of SNRs clearly was evident during the California wildfires in 2007 in which the SNRs were used to disseminate early notification and evacuation information to vulnerable individuals, and to assist with their sheltering needs. In some areas, utility companies maintain similar registries listing individuals who are dependent upon powered life-support systems and may even tag their meters for priority restoration of services.⁵

Although enrollment in these SNRs remains voluntary, the existence of such a registry is required by law in many places. In Florida, the United States, county SNRs have been used during hurricane seasons, and have proven to be mutually beneficial to both the enrollees and the local planners and responders. After the 1993 World Trade Center bombing, the New York City Port Authority responded to the needs of the buildings' vulnerable employees by purchasing devices and implementing systems that would aid in their evacuation. Areas of refuge were established, individuals requiring assistance were identified, and drills were conducted. The Associated Blind Organization worked with the New York Fire Department to develop a building evacuation plan and exercises for the management of individuals with blindness or limited vision. As a result of these efforts and the commitment of their co-workers, many vulnerable individuals survived the 11 September 2001 attacks in New York City.⁶

An essential part of disaster and emergency management is the engagement of members of vulnerable groups with specialized needs, representatives from advocacy groups, community-based organizations, and social service agencies in preparedness, response, recovery, and mitigation activities.⁷ These individuals and groups can provide the requisite guidance, technical assistance, and linkages to community-based organizations and providers of highly specialized services. In order for a community to achieve coordinated and integrated disaster and emergency planning at every level, it is incumbent upon agencies within the local infrastructure to revise their Emergency and Disaster Medical Plans so that they are responsive to the needs of the vulnerable populations within their community.

VULNERABLE GROUPS

Older adults, children, the economically disadvantaged, individuals with low levels of education and corresponding literacy, individuals residing in single-parent households, households headed by individuals with a disability, individuals with limited primary language skills, minorities, the homeless, individuals with certain ethnic or cultural characteristics, migrant/itinerant workers, and individuals who are geographically isolated, socially isolated, or otherwise disenfranchised represent a small list of vulnerable individuals and groups within a given population.

Individuals within vulnerable groups regularly rely on a network of family members and agencies to provide assistance, maintain optimal health, and independence. Emergency planning considerations must be extended to the entire family unit or support unit, rather than solely to the vulnerable individual. Consideration also must be given to service animals that provide a range of support upon which their companions depend.

These vulnerable groups are not always distinctly separate; coupled with a lack of concise definitions, this adds to the challenges of identifying these groups within a local community and planning for their needs. The overlapping of some services often occurs as a result of the broad inclusiveness needed to ensure identification of the wide variety of diverse individuals with special needs.

It is important to note that certain demographic characteristics, alone or in combination with others, place individuals and families at increased risk, making them more vulnerable than other persons to the adverse effects of disasters. Many of these characteristics are interrelated and their effects are cumulative. For example, limited financial reserves and reliance upon public transportation will put a family at a disadvantage in the event of a disaster, as they likely will not be able to afford to have a cache of food and supplies, and would be dependent upon public transportation for evacuation to a shelter. Limited language skills may be barriers to receiving important warnings and notification, as well as issues with transportation, evacuation, and sheltering. Language barriers also may interfere with appropriate application for assistance, housing, and relocation during the recovery process. Racial and cultural factors also may result in perceived or actual bias, discrimination, and barriers, and should be considered in preparedness, response, and mitigation activities.

Persons with Disabilities

The Americans with Disabilities Act (ADA) defines disability as: “a physical or mental impairment that substantially limits one or more of the individual’s major life activities, such as caring for one’s self, performing manual tasks, walking, seeing, hearing, speaking, breathing, learning, and working”.⁷ For purposes of disaster and emergency planning, it should be noted that this definition, while broad, does not account for the severity or duration of the stated

disability, thereby failing to include those disabled individuals not meeting the strict criteria.⁷

The US National Council on Disability and the National Organization on Disability both recommend considering the issue of disability broadly and caution against using narrow definitions in emergency and disaster management activities. The National Council on Disability notes that the term *disability* does not apply exclusively to people with noticeable disabilities, but also to people with heart disease, emotional or psychiatric conditions, arthritis, significant allergies, multiple chemical sensitivities, respiratory conditions, and some visual, hearing, and cognitive disabilities. The National Organization on Disability warns that it is important to realize that people with disabilities, even more than other demographic segments of the population, are not a homogeneous group, as individuals differ in their individual capabilities.^{2,5}

Service Animals and Pets

Many people with disabilities rely upon a service animal for assistance with day-to-day activities. Assistance Dogs International defines a service animal as “any guide dog, signal dog, or other animal individually trained to provide assistance to an individual with a disability.”⁸ Animals meeting this definition are to be considered service animals, regardless of whether or not they have been licensed or certified by a state or local government. Not all states have a credentialing program for service animals, and not all service animals wear duty vests or leashes, making it difficult to distinguish a service animal from a family pet.⁸

A service animal is an integral part of an individual’s support unit and should not be separated from the person who relies upon its services; separation jeopardizes the individual’s independence. In times of a disaster, hospitals, shelters, alternate care facilities, first-aid stations, feeding stations, and Disaster Recovery Centers are among the most likely venues for interactions with people who have service animals. Disaster healthcare plans should include guidelines for accommodating these special need victims, particularly in these venues. The service animal also should be incorporated into planning for transportation, evacuation, and relocation activities.

Many non-disabled individuals and families rely upon the companionship and comfort of their pets and feel the need to remain close to them during times of emergencies and disasters, often forsaking their own safety. The strength of the human–animal bond is so strong that many individuals and families have intentionally placed themselves in great peril by refusing to evacuate or seek refuge in shelters where pets are prohibited. As a result, many initiatives at the local, state, and federal levels have been initiated to make the process of evacuation and shelters more “pet friendly”. Both the Humane Society of the United States and the American Veterinary Medicine Association (AVMA) provide

leadership, expertise, and education on disaster preparedness for pets (www.avma.org).

The AVMA's disaster and preparedness efforts date back to 1993, when a memorandum of understanding (MOU) was established with the Office of Emergency Preparedness of the US Public Health Service. Veterinary services were incorporated into the US Federal Response Plan (currently known as the National Response Framework) as part of the National Disaster Medical System and the development and implementation of the Veterinary Medical Assistance Teams. The AVMA also works with the US Department of Agriculture/Animal and Plant Inspection Service in response to animal disease outbreaks.⁹

Elderly

Many of the deaths resulting from Hurricane Katrina were among the elderly, with the majority occurring in the New Orleans metropolitan area. In Louisiana, nearly 71% of the hurricane victims were over the age of 60 years, and 47% were over the age of 75 years; most perished in their homes or within the community. In New Orleans, 73% of the deaths directly related to Hurricane Katrina occurred among persons over the age of 60, yet this population comprised a mere 15% of the city's total population.¹⁰ Sixty-eight deaths resulted from abandonment by caretakers in nursing homes. Additionally, an estimated 1,300 older adults who lived independently prior to Hurricane Katrina subsequently were placed in nursing homes after the event.¹¹

Much of what constitutes the vulnerability in older adults can be attributed to the following factors: medical conditions and functional limitations, socio-demographic characteristics; and psychosocial characteristics, all of which frequently are inter-related and exacerbated in a crisis or disaster. Vulnerabilities stemming from medical conditions and functional limitations are characterized by a wide variety of chronic illnesses, impairments, and dependence upon medications, assistance devices, and technology. Many older individuals experience at least two or more chronic conditions concurrently, affecting their stamina, mobility, and physical functioning.¹⁰ Diabetes, renal disease, heart disease, emphysema, arthritis, and a host of other chronic diseases can be exacerbated rapidly before, during, and in the aftermath of a disaster, even if they have been well-managed previously. Stress, exertion, and even mild exposure to environmental debris and toxins that are common after the precipitating event can exacerbate chronic respiratory conditions, decrease stamina, and increase fatigue.

Functional limitations in an older adult may appear gradually over a long period of time, impairing mobility and sensory abilities. Chronic diseases may take their toll on vision, hearing, cognitive processes, and mobility, often rendering an older adult with limitations similar to those of a disabled person. Gradual deafness and hearing loss can result in the need for hearing aids, sign language,

and closed captioning. Limitations with vision and mobility as a result of chronic or acute disease states, illnesses, or injuries will contribute to the vulnerability of an older adult and may be compounded by cognitive impairments. Individuals with limitations that have developed gradually over a number of years may not even consider themselves to have limitations or disabilities.

Sensory and cognitive impairments caused by diabetes, neurovascular diseases, strokes, and Alzheimer's disease are common in older adults and increase their vulnerability. With the progression of these disease states, it becomes increasingly difficult for older adults to adequately process and articulate their needs. Changes in routines, travel, and unfamiliar environments (such as a post-disaster relocation) can cause agitation, wandering, hallucinations, delusions, and sleep disturbances in persons with dementia, further complicating the situation. The Alzheimer's Association recommends the following tips for preventing agitation:

- Continuously reassure the person with dementia that "everything is fine";
- Hold the hand of the person with dementia;
- Find outlets for anxious energy by walking together;
- Provide brief explanations with reassurance and frequent reminders that the person with dementia is where they are supposed to be;
- Look for behavioral cues that the person with dementia is overwhelmed; and
- Maintain the medication regimen of the person with dementia.

The Alzheimer Association's Safe Return® program has an enrollment of 140,000 older adults; if an enrolled member is missing, one call to the program triggers activation of a community-based support network.¹² Advocating for the enrollment of appropriate individuals in such programs and SNRs can be integrated into disaster and emergency planning activities at every level, beginning with individuals and their families (Appendix 16A).

Fifty-one percent of people over the age of 65 years take more than three prescription medications each month, and many are on such a complex regimen of medications that even temporary alterations to that regimen could result in serious, if not fatal, complications.¹⁰ During the active 2004 US hurricane season, 14,000 elderly patients presented to EDs in the affected areas of Florida for prescriptions and oxygen; this number escalated to 25,000 in the aftermath of Hurricanes Katrina and Rita in the US Gulf Coast states, primarily Louisiana, Alabama, and Texas.¹⁰ In addition to the loss of medications and prescriptions, the lack of available medical records during disaster events, as well as disruptions in clinic and primary care provider services, have added to the difficulty of ensuring that the elderly are provided their correct medications in the correct dosage.



The US Department of Veteran Affairs is structured to maintain the continuity of operations and delivery of services to the veterans it serves. The Veteran Affairs (VA) system consolidates patient identification, and provides tracking using bar codes, so that both inpatient and outpatient providers can access a veteran's military history, medical history, other pertinent information, and pharmaceutical information. All these data are linked to nationwide VA Medical Centers, community-based outpatient clinics, and pharmacy chains, facilitating the medical treatment of veterans during disaster evacuation and relocation.¹⁰ Implementation of a similar system for recipients of US Medicare and Medicaid healthcare coverage would provide for healthcare continuity and integration for millions of vulnerable people who are covered under these healthcare programs. The management of patient information during disasters in developed countries with socialized medicine likely would reflect examples of best practices and lessons learned.

NEEDED SERVICES

The elderly's vulnerability during disaster events will continue to increase as this population increases due to declining mortality rates from cancers and other diseases, increasing longevity, and improved medical technology and pharmaceutical therapy. All of these factors increase the elderly's dependence on the uninterrupted delivery of medications, health care and social services.

Medical Equipment Needs

Similar planning consideration should be given to the needs for durable medical equipment, medical devices, and their associated electrical power requirements. Use of medical devices and technology in private homes, while not exclusive to the older adult, is so prevalent that the term *utility-dependent* has been coined. Ventilators, continuous positive air pressure, bi-level positive air pressure, and intermittent positive pressure breathing machines, suction devices, apnea monitors, oxygen concentrators, compressors, nebulizers, cardiac monitors, pulse oximeters, humidifiers, intravenous infusion pumps, feeding pumps, dialysis machines, environmental control systems, life-line systems, electronic door openers, electric beds, pressure beds, continuous passive motion devices, electric lifts, powered scooters, and external battery chargers are dependent upon an electrical source for continuous operation. These types of devices sustain health and are essential to maintaining and preserving the quality of life for an ever-increasing number of individuals being cared for in their homes. The increased usage and dependence upon these medical devices have prompted utility companies to maintain registries for notification and prioritization for restoration of utilities following a power outage.

The reliance on large pieces of durable medical equipment in the home for transportation, sleeping, toileting, and other essential activities has established

the need for registries to track, locate, service, and re-supply items, as often they must be left behind in instances of evacuation and sheltering.³ It also has prompted those tasked with planning for and operating Special Needs Shelters and Medical Shelters to complete an MOU with area vendors and distributors in order to authorize and establish a supply and maintenance chain for durable medical equipment items when shelters are open and occupied.

Outpatient Services

A host of outpatient, but medically essential, services require continuation during an emergency or disaster to maintain quality of life, e.g., hemodialysis, radiation treatments, chemotherapy and rehabilitation services. Any disruption of these services represents a potential for regression or deterioration of an already compromised state of health. Strategic planning at all levels within the health-care delivery system should provide for the continuation and accessibility of these critical services, even if they must be delivered outside of the affected area. Use of an SNR can assist disaster and emergency planners and healthcare providers in ensuring that the individuals in need of these services have access to them during and in the aftermath of disasters.

Many individuals with age-specific needs, disabilities, and mental illnesses are living in nursing homes, skilled nursing centers, assisted living facilities, hospice centers, and other congregate care centers and half-way houses. Although these facilities are required by a variety of oversight and regulatory agencies to develop EMPs, including a variety of internal and external scenarios, there is much variance in the depth, quality, and functionality of these plans. Integration of these plans within the community response and inter-agency coordination are critical in identifying deficits in existing resources and unrealistic expectations on the part of the facility's administration.

STRATEGIES

The National Organization on Disability, the National Council on Disability, the American Association of Retired Persons, and the American Academy of Pediatrics are just a few US advocacy organizations that have taken steps to identify current deficits in planning assumptions with respect to the at-risk and vulnerable groups that they represent. While representing diverse populations, many findings and subsequent recommendations set forth by these agencies are similar in concept and support the overarching goal of enhancing all aspects of disaster management for individuals with vulnerabilities and special needs.

These agencies have developed and published strategic initiatives, lent guidance to Federal agencies, and implemented changes in policy, legislature, and the culture of disaster management. Advocacy agencies share the overarching goal of enhanced disaster management for their constituents as evidenced by their

targeted strategic initiatives to address the issues of: (1) improved accessibility to communication, transportation, evacuation, and sheltering; (2) continuity of care and lifelines, while stressing the abilities of their constituents, promoting integrated and coordinated planning; and (3) preparedness at the individual, caregiver, and institutional levels.

Some of these strategic initiatives include:

- An Interagency Coordinating Council on Emergency Preparedness and Individuals with Disabilities established by Executive Order in July 2004, to address the needs of persons with disabilities and provide guidance for federal agencies;¹³
- The 2005 White House Conference on Aging included, as one of its 50 top-ranking priorities, “The Development of a Coordinated Federal, State, and Local Emergency Response Plan for Seniors in the Event of Public Health Emergencies or Disasters”;¹⁴ and
- The Federal Emergency Management Agency’s Diversity Outreach Initiative, initially developed and implemented to provide information on disaster assistance and basic immediate needs to Hurricane Charley victims with language barriers and disabilities at Diversity Outreach Centers throughout Florida. Subsequent partnerships with state and local governments, advocacy agencies, and private organizations furthered the outreach efforts to help with food, clothing, and other needs.¹⁵

There are many commonalities among the needs of older adults, children, and persons with disabilities, and they share many issues with people whose vulnerabilities result from a number of complex and inter-related demographic, economic, and social factors.

Locating the Vulnerable Groups

There is no one database that provides a complete snapshot of a community’s population. Individuals and vulnerable groups with specialized needs must be located through information obtained from multiple data sources, each with limitations based on inclusion criteria, the age of database, and the origin of the data. Census data often are available readily and can be used as a starting point for gathering a broad perspective of the community’s demographic information. SNRs, if utilized, are an invaluable resource for disaster and emergency planners and provide a lifeline for their vulnerable enrollees. However, while individual enrollment in SNRs is encouraged, for the most part it remains voluntary; these data, then, are only available on those who “self-identify” via enrollment. To further complicate matters, a community may experience seasonal shifts in demographics and vulnerable populations, particularly if it is in close proximity to a college

or university, attracts seasonal tourists, has residential summer camps, or utilizes a migrant worker population.

Local health departments, social service agencies, and community health centers also may serve as sources of data and be able to provide contact information for adult and pediatric day-care centers, homeless shelters, and shelters for victims of spousal and child abuse. Careful attention should be paid to community health centers, which provide services for vulnerable groups that are geographically isolated, uninsured, underinsured, indigent, and/or those dealing with numerous economic and social challenges.

Advocacy organizations, faith-based organizations, and community-based organizations also have data on the groups to which they provide service and can provide valuable insight regarding methods of information dissemination, and the accessibility barriers of the population that they serve. Some agencies and organizations are prohibited legally from sharing their databases and others may be reluctant to do so, citing privacy and trust issues.

Additionally, utility and telecommunication companies maintain databases of “priority” status households, i.e., those in which electricity is vital to maintain medical equipment and telephone communication provides necessary linkages to “life-lines.” Having access to points of contact within the local utility companies and phone service providers, and developing strong working relationships with them ultimately will benefit the community’s planning and preparedness activities.

Appendix 16A provides a comprehensive listing of potential community data sources and resource agencies.

Barriers to Information and Communication

Public information regarding personal and family preparedness, notification of a pending or recent disaster, evacuation orders, shelter locations, transportation, available services, locations of Disaster Recovery Centers, relocation, and mitigation are types of information that an affected community must receive. Many of the traditional information dissemination methods are not accessible for people with cognitive or sensory limitations or disabilities, and individuals with limited language skills or literacy limitations. These communication barriers are not confined to the disaster warning and notification phases, but continue through the response and recovery phases as well, such as during evacuation and while in shelters and assistance centers. Having a reliable network of family, friends, and neighbors to receive, interpret, and disseminate vital information is an important part of personal and family planning for vulnerable populations.

People with hearing impairments or who are deaf cannot rely on radio, television, sirens, or other audible alerts for their information. Text tele-

phones (TTY) with a keyboard and a viewing screen are used to aid individuals who have hearing or speech impairments communicate via the telephone, relay operator, or a communications assistant to transmit and translate the call through the Telecommunications Relay Services (TRS). The US TRS, which is a nationwide system, also is used for reverse 911 calls and telephone trees for registered users. Closed captioned information on television, sign language interpreters, as well as video and internet relay systems are other methods for information dissemination, but each has its own inherent limitations, necessitating that additional methods be employed to ensure redundancy. Such redundancy may include technology-based platforms, such as text messaging pagers, with alerts for weather and other news that can be linked to emergency management warnings. Information also can be sent through e-mail, personal digital assistants (PDAs), other web-based devices, as well as video relay services available through broadband communications systems. However, Internet and broad-band access are not available worldwide, and this technology may be too complicated for use by many individuals.

Access to information written in Braille, printed in a large font type, or provided in a real-time audio format is crucial to ensuring the dissemination of information to the visually impaired and blind community. Providing accessible information for the blind and visually impaired is best accomplished by working with advocacy agencies within the community during every phase of emergency and disaster management, as these agencies already have accessible communications networks, established platforms for information dissemination, and the appropriate means with which to deploy them.

Information dissemination for individuals with cognitive impairment and disabilities, i.e., dyslexia, autism, attention deficit hyperactivity disorder (ADHD), Tourette's syndrome, stroke, traumatic brain injuries, and Alzheimer's disease and other dementias, requires assistance from corresponding advocacy agencies in the crafting and delivery of public information.

Many individuals with a cognitive impairment live independently and experience confusion and anxiety with even minor emergencies, making decision-making during a disaster tenuous. Use of augmentative communication devices (e.g., laptops, word boards, simple, picture-oriented communication charts, or, possibly, an artificial larynx) should be considered. Enrollment in the local SNR and having a personal and family plan that includes a strong and committed support network is essential to individuals with any degree of cognitive impairment. Their human network will assist in providing redundancy in the communication of vital information during emergencies and disasters when other sources are disabled by loss of telecommunications and electricity.

Additionally, socioeconomic constraints may preclude many from accessibility to radios, televisions, computers, telephones, and even newspapers with-

in their residence. Cultural and ethnic issues may cause individuals to question the reliability and accuracy of the information disseminated.

During and following a disaster, limitations in accessibility to information will hamper an individual/family's ability to apply for and receive disaster assistance, i.e., financial aid, clothing, food, relocation, and enrollment in local, state, and federal programs. Failure to receive this information in a timely fashion could mean missed timelines and deadlines for applications, delays in much-needed assistance of all types, and unnecessary setbacks in moving forward to recovery from the disaster. Communication is vital throughout all phases of a disaster for all members of a community and gaps in accessible communication in any phase can render the individual or group even more vulnerable to the adverse consequences of a disaster.

Accessible Transportation

A lack of accessibility to transportation, private or public, for the purpose of evacuation and movement to safety and shelter leads to increased vulnerability. The economically challenged, the elderly, individuals with mobility and visual impairments, as well as individuals with healthcare issues may not own or be capable of operating a private vehicle to transport themselves and their family members during evacuations. Individuals with a privately owned vehicle may not be able to obtain needed fuel to evacuate themselves out of the disaster area.

Although school buses and other vehicles may be used to augment the public transportation system in times of disaster, many are not equipped with lifts that are necessary for people using wheelchairs and others with mobility impairments. Therefore, this is not an option for many individuals with physical limitations due to health conditions. Early warning and evacuation of the special needs population using public transportation buses that are handicap-accessible, school buses and other vehicles that have been retrofitted with lifts or are currently utilized for the transportation of individuals with disabilities, provide some additional options. These options, however, are limited and can become quickly exhausted in the event of late evacuation orders or when large numbers of individuals with physical limitations are solely dependent upon public transportation as a means of evacuation.

Accessible Shelters

Disaster and emergency planning should include a survey of identified shelter sites to determine their accessibility and ability to accommodate individuals with disabilities, hearing, vision, mobility, and cognitive impairments, age-specific needs, and chronic medical conditions. Specific consideration must be given to identifying issues regarding ingress and egress, wheelchair accessibility, width of hallways, lighting, and necessary signage.

Conversely, not everyone who has specialized needs may need to be excluded from a general-purpose shelter. The addition of a teletypewriter/telecommunications device, sign language interpreters, message boards and other communication boards, large font signage, and bilingual interpreters in general population shelters will enhance accessibility for many individuals who might otherwise not be able to be accommodated in these shelters. Furthermore, placement of all older adults or individuals with a disability or impairment who otherwise live independently into Special Needs or Medical Needs Shelters is inappropriate. Careful intake screening can minimize the inappropriate placement of individuals. Shelters for people with disabilities, functional impairments, cognitive impairments, individuals with utility-dependent, life-saving medical equipment, individuals with chronic conditions requiring a comprehensive regimen of pharmaceuticals and oxygen, and/or individuals who require durable medical equipment or are dependent upon a network of skilled providers need to be staffed by healthcare professionals with access to pharmaceuticals, durable medical equipment, and replenishment of expendables. Ensuring that shelter occupants will be tracked and that their continuity of care issues are addressed is critical. Shelters receiving the terminally ill should enlist the advice and council of local hospice providers to ensure that the end-of-life experience be as dignified, comfortable, and appropriate as possible.

Accessible Disaster Resource Centers

Centers that provide services and assistance to an affected population in the aftermath of a disaster should review carefully the facility, the process involved in applying for assistance and services, and the staff to identify accessibility issues. A complex application process that requires standing in long lines will present barriers for individuals with cognitive and functional limitations. Extensive paperwork in the absence of multilingual staff or individual assistance for people with low literacy issues, will limit accessibility. A staff lacking diversity and sensitivity to effectively communicate and assist with age-specific needs, ethnic and cultural issues, as well as the many other previously identified concerns, likely will not be able to adequately assist vulnerable individuals during a time when they are most in need of assistance in order to begin the recovery.

CONCLUSION

Of all of the components comprising the local infrastructure, it is the healthcare system, and more specifically the hospital — with its respective emergency planners, facility managers, engineers, and healthcare providers — that provides the largest pool of individuals with experience in preparing for, responding to, and assisting with the needs of vulnerable individuals and groups. Hospital and healthcare personnel, particularly nurses, are well-positioned to take an active role in assisting community disaster and emergency planners. Nurses are aware

of the healthcare issues specific to their community's population, and possess extensive experience in collaborating with outside agencies to coordinate and integrate care delivery. Nurses are positioned to advocate for the inclusion of the specialized needs of a rapidly growing and demonstrably vulnerable segment of our population into all levels of disaster and emergency management doctrine and dogma.

MYTHS REGARDING THE ELDERLY IN EMERGENCIES/DISASTERS

HelpAge International is a global network that works in partnership with community-based organizations as well as other non-governmental organizations (NGOs) to address the needs of the vulnerable elderly population in emergency situations. Included among their reports are the following six myths concerning older people in emergencies and disasters:¹⁶

Myth 1: The extended family and community will protect older people at all times. Following the Southeast Asia tsunami, >9,000 older individuals were overlooked in terms of assistance;

Myth 2: An agency will look after older people. There are no UN agencies and only a few international NGOs that target the elderly;

Myth 3: Older people can be covered by general aid distributions. The special requirements (nutritional, cultural, physical) of many elderly are not met by general relief distributions;

Myth 4: Older people have only themselves to worry about. Increasing numbers of the elderly are responsible for their children or grandchildren;

Myth 5: Older people are waiting to be helped. Most elderly want to provide for themselves, regain control of their lives, and contribute to the community as much as possible; and

Myth 6: Older people are too old to work. Many elderly still contribute economically to their households and play key decision-making roles.

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Appendix 16A: Potential sources of data and resources for special needs populations in the United States

ORGANIZATION

Disability Resources

The Access Board
 National Council on Disability
 National Organization on Disability
 American Association for People with Disabilities
 American Foundation for the Blind
 National Association of the Deaf
 Los Angeles City Department for Disability
 Federal Emergency Management Agency (FEMA)
 New York City Office for People with Disabilities
 Easter Seals
 The American Red Cross
 The American Red Cross
 Center for Independence of the Disabled
 Federal Communications Commission (FCC)
 US Department of Justice (DOJ)
 Department of Homeland Security
 US Department of Labor (DOL)
 Gallaudet University, Laurent Clerc
 National Deaf Education Center
 Telecommunications for the Deaf, Inc.
 United Spinal Association
 The National Council on Independent Living
 The Arc of the United States
 The Office of Disability Employment Policy
 The Job Accommodation Network
 The Americans with Disabilities Act
 The Center for an Accessible Society

Service Animal Resources

Service Animals
 Humane Society of the US
 Guiding Eyes for the Blind
 Amazing Tails, LLC
 Guide Dogs
 International Association of Assistance Dog Partners
 National Service Dog Training Center
 National Education for Assistance Dog Services
 Dogs for the Deaf, Inc.
 The Seeing Eye

Age-specific Resources

Nursing Homes
 Department of Health and Human
 Services Administration on Aging
 Alzheimer's Association
 National Resource Registry
 HelpAge International

General Information Resource

US Census Bureau

Communications Resources

Federal Communications Commission
 Gallaudet University ABLEDATA
 Lighthouse International
 Bobby Web Accessibility Software Tool

WEBSITE

www.access.board.gov
www.ncd.org
www.nod.org
www.aapd.com
www.afb.org
www.nfd.org
www.lacity.org/DOD
www.fema.gov
www.NYC.gov/mopd
www.easter-seals.org
www.arc.org
www.prepare.org
www.cidny.org
www.fcc.gov
www.usdoj.gov
www.dhs.gov
www.dol.gov/odep

www.clercenter.gallaudet.edu
www.tdi-online.org
www.unitedspinal.org
www.ncil.org
www.thearc.org
www.dol.gov/dol/odep
www.jan
www.ada.gov
www.accessiblesociety.org

www.disability-resource.com/dogs.html
www.hsus.org/hsus_field_disaster_center
www.guidingeyes.org
www.amazing-service-dogs.com
www.guidedogs.com/au
www.iaadp.org
www.nsd.on.ca
www.neads.org
www.dogsforthe deaf.org
www.seeingeye.org

www.nursinghomeaction.org

www.aoa.dhhs.gov
www.alz.org/safereturn
www.nerr.gov
<http://helppage.org>

<http://quickfacts.census.gov/qfd/states>

www.fcc.gov
www.abledata.com
www.lighthouse.org
<http://bobby.watchfire.com>

ORGANIZATION

Communications Resources

W3C Web Accessibility Initiative Resources

The Federal Government's Section 508 Resource

NOAA Weather Radio

Modern Language Association Language Map

Preparedness Resources

Ready America

US Fire Administration

National Fire Protection Association

WEBSITE

www.w3.org/WAI/Resources/#gl

www.section508.gov

www.weather.gov/nwer/special_needs.htm

www.mla.org

www.ready.gov/america

www.usfa.fema.gov/safety/atrisk

www.nfpa.org



CHAPTER 17

DISASTERS AND CHILDREN

Karen Olness

PLANNING FOR THE CARE OF pediatric victims in disasters often is overlooked in disaster preparedness. A survey from a national consensus conference on pediatric disaster preparedness found that 98% of the pediatric experts felt that the US public health system was not addressing key needs in pediatric preparedness, and <6% felt that the healthcare system would be able to provide proper care of pediatric victims of a terrorist attack.¹ Children can be, and often are, victims in all types of disasters. Healthcare planners and providers should not assume that children's unique needs would be met using the planned methods and interventions developed for the adult population.

OBJECTIVES:

- List special considerations in planning for children in disasters;
- Describe interventions that may prevent long-term psychological problems in children who experience disasters; and
- Identify sources for additional information regarding caring for children in disasters.

During disasters, children are at risk for both short-term and long-term health problems because of poor judgment skills, an inability to advocate for themselves, a lack of physical strength, and limited biological reserves.² Pediatric victims' condition can deteriorate rapidly from stable to life-threatening, they may not be receptive to responding personnel, and they have widely varying reactions and abilities to communicate due to their different developmental stages and coping abilities.^{1,3} Children also may not have the ability to escape a particular "danger zone", and may even run toward the danger rather than away from it.⁴ Additionally, children are influenced by their parents or caretakers, who, themselves, may have difficulty coping or who may be experiencing prolonged physical and mental health problems related to the disaster.⁵

CHILDREN IN DISASTERS

Unfortunately, children can be involved in terrorist events, either directly or indirectly. Indirectly, they may become unintentional or inadvertent victims simply by being in the “wrong place at the wrong time”. Examples of this include the 15 children present in the day-care center housed in the Murrah Federal building at the time of the Oklahoma City, in the United States, bombing in 1995, and the children who were passengers on the trains during the Madrid, Spain, bombings in 2004.^{6,7} Children also can be the direct, intentional targets of terrorists, such as occurred in the 2004 Beslan school siege in Russia in which >1,100 students and their teachers were held hostage for several days. Ultimately, 186 children were killed, and hundreds of children were wounded in this attack.⁸

Children inevitably are caught up in the effects of disasters from natural events, including becoming displaced and separated from their caregivers. Many children who arrived at the Houston Astrodome after being evacuated from New Orleans, the United States, during Hurricane Katrina suffered traumatic separation from their parents.⁹ After the Asian tsunami of 2004, Indonesian officials estimated that 35,000 Indonesian children lost one or both parents in the disaster. There also were reports of child-trafficking gangs abducting unaccompanied, displaced children.¹⁰ Children represent half of the population displaced by complex emergencies, whether from natural or man-made hazards, and they account for 70% of all deaths that occur in these events.^{11,12}

PHYSICAL VULNERABILITIES

Due to a variety of physiological factors, children have certain inherent vulnerabilities to certain terrorist events. Children have a greater skin surface-to-weight ratio and thinner skin than do adults, leaving them more vulnerable to the absorption of toxins and more susceptible to hypothermia.¹³ Children's respiratory rates normally are more rapid than those of adults, causing them to inhale a greater amount of aerosolized substances and sustain greater respiratory effects from chemical agents and radioactive materials. Compared to adults, children are shorter and, therefore, closer to the ground where these agents, many of which are heavier than air, have the highest concentration.³ Because of an immature immune system, and because many of their organs may not be developed fully, children also lack an adult's capacity for excreting toxins and, consequently, may receive higher doses or concentrations of a released agent.¹⁴ Children also have less fluid reserve than do adults, which increases their risk of hypovolemic shock from blood loss, or from rapid dehydration from the vomiting and diarrhea induced by some agents.³

In blasts, children are more vulnerable to ocular injury due to their limited ability to shield their eyes. They are at great risk for airway compromise

due to their smaller airway; children also may absorb a greater proportion of the blast energy than adults.¹³ Children exposed to radiation have increased long-term risks of thyroid and breast cancer compared to adults.¹³

The stress of a disaster experience has been associated with immunosuppression in children; this can cause them to be more susceptible to infectious agents that abound in the aftermath of disasters due to crowding and poor sanitation.¹⁵ In disaster situations, children can develop severe malnutrition in as short a time period as two to three weeks as a result of inadequate food intake, infectious diarrhea, or both. Major causes of child mortality and morbidity in disaster situations, as identified by the World Health Organization (WHO), include:¹⁶

- Diarrhea diseases;
- Respiratory infections;
- Measles;
- Malaria;
- Severe bacterial infections;
- Malnutrition;
- Injuries;
- Burns; and
- Poisoning

TRAUMATIC INJURIES IN PEDIATRIC VICTIMS OF THE OKLAHOMA CITY BOMBING

In the Oklahoma City bombing in 1995, 19 children died from multiple traumatic injuries caused by the collapsed surrounding structure. Chest and abdominal injuries were common among the children; 90% of the pediatric fatalities sustained skull fractures. Blunt trauma from falling or flying debris can cause significant injuries to the internal organs of children with no external signs of fractures or other trauma.¹⁷ Children's ribs are more flexible than are those of adults, and they have less tissue protecting their heart and lungs; thus, pulmonary contusions can occur readily. As the diaphragm in a child may rise as high as the nipple line, abdominal trauma may occur along with chest trauma. In young children, the liver is less protected by the rib cage, thus increasing the risk of liver laceration with blunt trauma. Because the head of a child is relatively large compared to the rest of his/her body, traumatic brain injury is seen commonly in children. However, the high percentage of skull fractures noted in the pediatric victims of the Oklahoma bombing/building collapse also may have been due to the inability of the children to escape the falling debris.

Jonathan Mould

PSYCHOLOGICAL AND/OR BEHAVIORAL RESPONSES

Children become frightened and confused during a disaster. They fear for their safety not only during and following the event, but, perhaps, even before it occurs, if they have been made aware of an impending event from the media or family. They also may experience anxiety over separation or potential separation from their parents or caregiver. They may be experiencing grief over the loss of a family member or caregiver. Upon arrival at a healthcare facility, they may be anxious and frightened because of the unfamiliar place, people, and procedures. Their fears and concerns may manifest as withdrawal, anger, or panic. The psychological and/or behavioral responses of children who experience disasters vary depending on their age, developmental stage, and temperament.¹⁸ Reactions, particularly those of younger children, are influenced by the reactions of their parents and caregivers; they likely will react in a similar manner. Table 17.1 lists common reactions to traumatic events during different childhood developmental ages.¹⁹

Pre-school (Age 1–5 years)	Early Childhood (Age 6–11 years)	Adolescence (Age 12–17 years)
Regression Bedwetting Hyperactivity Aggression or withdrawal Fear of strangers Clinging to parents Sleep disturbances Loss of appetite	Aggression Difficulty concentrating Decline in school performance Attention-seeking behaviors Withdrawal	Disruptive behavior Withdrawal Vague physical complaints Attention-seeking behaviors High-risk behaviors

Table 17.1: Common reactions to traumatic events at various developmental ages¹⁹

Both school-age children and adolescents may develop post-traumatic stress disorder (PTSD), although manifestations may be less obvious than in adults and depend on the child's developmental stage and brain maturity. One study conducted following the 9/11 terrorist attack in New York City, found that 18% of New York City children had signs of PTSD.²⁰ A study of Thai children in tsunami-affected areas found that PTSD symptoms were evident in 13% of children living in camps, and 11% of children from affected villages.²¹ Events that are most likely to lead to mental health problems in children include: (1) the death or physical injury of a family member; (2) loss of home and possessions; (3) relocation of the family; (4) parental job loss; and (5) parental disorganization or dysfunction associated with the disaster.²² In addition, research has demonstrated that children can develop significant psychological symptoms from simply watching media coverage of a disaster or by hearing about the events.²⁰

Factors that promote resilience in children who experience disasters include: (1) strong, early bonding with loving parents; (2) an uninhibited temperament; (3) a strong personal coping ability; (4) a sense of humor; (5) the presence and availability of a caring adult; and (6) continuation of the routine activities in daily life.²³

Sleep disturbances are common after any traumatic event, including disasters. One review reported sleep disturbances in more than half of the children who had experienced a terrorist attack, a fatal sniper attack on a school playground, the death of a friend by lightning, an earthquake, and/or a hurricane.²⁴ Most sleep disturbances following a disaster cease within a few months. If they persist, children must be evaluated by a healthcare professional to identify the cause of the problem and receive appropriate treatment.

Cultural issues may make it difficult to recognize mental health disorders in a child or adolescent in a disaster situation. It is helpful to ask parents, relatives, and caretakers about changes they have noted in a particular child. Do play activities seem normal? Are they re-enacting disaster experiences in their play? Are the children showing regressive behavior? Are there problems sleeping or eating? If children are old enough to draw, what kind of drawings are they making? There are several screening instruments that may be helpful in assessing the mental health of school-aged children affected by a disaster.²⁴ The University of California at Los Angeles (UCLA), the United States PTSD Reaction Index is one such screening test that assesses individuals for 17 symptoms of PTSD and two associated symptoms (i.e., guilt and fear of the event recurring).²⁵ Selecting appropriate screening tests must take into account the child's language, age, and culture; not all tests are validated outside of western countries.

PLANNING

It has been recommended that the healthcare system be prepared for a disaster in which at least 15–20% of the victims are children, and that all facilities have drills that involve pediatric scenarios.²⁶ Hospitals that do not see pediatric patients routinely still must be prepared to care for children during a disaster. It has been demonstrated that a large portion of disaster victims bypass on-scene triage and treatment efforts of emergency medical services (EMS), and proceed to the nearest hospital, whether or not that hospital has pediatric resources.²⁷ According to a survey conducted in 2004, New York City had 248 pediatric intensive care beds with a surge capability of only an additional 47 beds for pediatric patients.²⁸ During Hurricane Katrina, all pediatric beds in the US state of Louisiana were overwhelmed.²⁹ Pediatric resources are extremely limited in most communities. Disaster plans should include a regional system for the appropriate distribution of pediatric victims after initial triage, treatment, and stabilization.

Available community pediatric mental health resources should be identified and involved in both the planning and response phases of a disaster. Planning to have mental health workers be on-call and activated through a 911 center at the request of a field command or hospital, will help to ensure timely arrival of needed experts to assist in the care of pediatric victims and concerned family members.

TRIAGE

Standard triage systems (see Chapter 5) do not incorporate pediatric considerations into their treatment algorithms, and thus, are unsuitable for use with pediatric victims. For example, assessing a child's ability to obey commands may not provide an accurate picture of that patient's clinical status, since children have different abilities to follow commands according to their particular developmental stage. The JumpSTART is a modified version of the START Triage developed in 1995 to triage pediatric casualties between 1 and 8 years of age; it incorporates pediatric-appropriate assessments into the triage algorithm.³⁰ The Pediatric Triage Tape is another triage system that uses a child's measured body length to correlate with values of the physiological parameters assessed with the traditional adult Triage Sieve.³¹ As with any triage system, staff need to practice its use during drills and other training to ensure ongoing familiarity and proficiency with the triage system used in his/her healthcare facility.

In humanitarian emergencies or disasters involving a long-term impact to a community or region, children also must be evaluated to determine their level of dehydration. The WHO has added a "D" (for dehydration) to the standard triage "ABC" (airway, breathing and circulation) assessments.¹⁶ Diarrhea is one of the most common causes of dehydration and death in children under 5 years of age.¹⁶ Table 17.2 lists WHO's recommended assessment and treatment guidelines for dehydration in children.¹⁶

Other WHO screening assessments include checking for persistent cough, which could be due to asthma or tuberculosis, and checking for fever, which could indicate malaria, measles, meningitis, or sepsis. In areas at high risk for malaria, screening may include the use of rapid diagnostic tests (RDTs). However, testing is not necessary in children with fever when the number of malaria cases prior to the disaster has already established an epidemic in the area.

In humanitarian emergencies, it is important to have the proper equipment to measure children's height and weight as soon as possible after the event. Children under 5 years of age should be weighed and measured immediately and every 2 weeks until relative stabilization of food, housing, and medical resources occur. They should receive priority with respect to available food, and should be fed three or four times/day. Total nutrients for pre-

LEVEL OF DEHYDRATION	SEVERE	SOME	NONE
Signs	2 or more of the following signs are present: ➤ Lethargic or unconscious ➤ Sunken eyes ➤ Not able to drink or drinks poorly ➤ Skin pinch reverts very slowly	2 or more of the following signs are present: ➤ Restless, irritable ➤ Sunken eyes ➤ Drinks eagerly, thirstily ➤ Skin pinch reverts slowly	2 or more of the signs of "Severe" and "Some" dehydration are NOT present
Treatment	Intravenous fluids: 30 ml/kg in first 0.5–1 hour; then 70 ml/kg 2–5 hours later	Administer oral rehydration solution according to formula: $\text{Weight (kg)} \times 75 = \text{ml to be given}$ Administer oral zinc supplements	Observe

Table 17.2: WHO assessment and treatment guidelines for pediatric dehydration¹⁶

school children should include 100 calories/kilogram/day; higher requirements are necessary for malnourished children. Meals must be balanced with respect to protein, carbohydrate, fat, and supplemental vitamins, especially vitamins A and C.

CARE

Due to the previously discussed unique responses of children during a disaster, care should be directed toward creating a supportive and safe environment for the children. During evacuation, transport, sheltering, and presentation to a healthcare facility, every effort must be made to avoid separating children from their parent, family member, or caregiver. Avoiding separation helps the child limit fear and anxiety over separation as well as providing an extra set of hands to comfort and care for the child. Unaccompanied children should be assigned to a specific staff member, such as a child life specialist, if staffing allows, who will accompany them or stay in very close proximity to them during the child's triage and treatment. Keeping the adult and child together is important during decontamination procedures as a child's response can vary from one of glee to one of horror when seeing staff members garbed in full chemical protective suits directing them into tents with showers.

Efforts should be made to explain the processes and procedures to children, as their developmental age allows. This will somewhat alleviate their fear of the unknown, help them to feel that they are participating in their care, and allow them to ask questions.

Planning already should have created partnerships with local pediatric

mental health workers, counselors, and chaplains to work with the children and address any behavioral issues as they arise. These resources also should be available at the hospital for arriving family members who may be searching for their missing child.

Other steps that should be undertaken by relief workers early in a disaster to help prevent potential physical and psychosocial issues in children both in the long- and short-term period are:^{11,24}

1. Re-establish routines as soon as possible, even if they can only be temporary. This includes maintaining regular times for eating, bathing, sleeping, and playing. It is important that school-age children attend school. Schools should be organized as soon as possible after a disaster-producing event, even if it must begin outside or in non-school buildings. Play areas should be designated for children, and materials for play should be provided as soon as possible;
2. Locate and seek assistance from child health experts in the area (some may be present among the displaced persons). For example, nursery school teachers or daycare workers may be willing to organize activities for young children. Doctors and nurses may be available to assist with diagnoses, provide treatment, perform nutritional surveys, participate in immunization programs, and/or develop feeding centers;
3. Monitor the heights and weights of children <5 years of age every two weeks until relative stabilization of food, medical, and housing resources in order to recognize when children are becoming malnourished, and to be able to intervene promptly. Weight and height measurements are preferred to arm circumference measurements as they are more reliable;
4. Provide support and encouragement to parents. This may include finding useful activities for them, providing safe daycare for children so that parents can spend time on arrangements related to the re-establishment of homes, relocations, job applications, and assistance applications;
5. Support breastfeeding mothers with adequate food, liquids, and emotional support to reduce their stress levels so that they can continue to nurse their infants;
6. Identify unaccompanied minors and provide reliable caretakers and safe environments for them. Caretakers should be observed by the child health professionals who supervise programs for unaccompanied minors in order to be certain that they are not abusing their charges;

7. Locate community leaders who know the displaced families and can work with them to plan for their resumption of a more normal life;
8. Provide culturally appropriate food, including “comfort food”, if possible. Eating familiar food in a familiar way is important in all cultures;
9. Provide toys, drawing materials, small musical instruments, and balls to the areas in which displaced children are living; and
10. Access programs (e.g., the UN Children’s Fund (UNICEF) “Return to Happiness” program, the “Resilience Project,” and the “Early Childhood Development Kit”) that have been developed to help children regain a sense of normalcy and encourage hope and confidence among children who have suffered because of a disaster. (Available at www.unicef.org)

TRACKING

A national tracking system is crucial to ensure that children and parents/guardians can find each other if they become separated or, when separation is absolutely necessary for care, they can be reunited easily. This may involve using arm bracelets coded with matching numbers, and/or taking photographs with a digital camera, if available. Unaccompanied children can be photographed and, if they are able, provide their name and their parents’ names. This information can be shared with authorities at an established community

REUNITING CHILDREN AND PARENTS AFTER HURRICANE KATRINA

With limited rescue availability, and in an effort to at least save the lives of their children from Hurricane Katrina’s destruction, many parents pushed their children onto rescue boats, buses, and helicopters while they stayed behind to await later rescue. Thus, families became separated; most of them lost everything in the storm, including photographs of the children. Within days of the hurricane, the National Center for Missing and Exploited Children (NCMEC) established a 24-hour Katrina Missing Persons Hotline, a database of missing children, and contact with law enforcement agencies throughout the United States. The hotline received reports of nearly 5,000 children missing or dislocated as a result of the hurricane. Using retired law enforcement officers around the country, photographing all children without parents in shelters and other facilities, circulating photographs to the television media, and using its database to link leads and analyze cases, the Center was able to reunite 87% of the children with their relatives within three months of the event; by six months, 100% of the missing children had been reunited.³²

Elaine Daily

reunification center or emergency operations center to help match the child with searching parents/guardians.

CHILD PROTECTION CENTERS

Based on the magnitude of the disaster, pediatric holding areas must be established for uninjured, displaced children. These may be in a location provided by the community or may be established at an individual hospital, depending on the numbers of unaccompanied children involved in the event. Children remain at the holding area either until they can be reunited with parents/guardians, or until local authorities can make other arrangements. Police or hospital security need to be in place within the area to control access to the area. Staff, such as child life specialists and counselors, need to be present in the holding area to care for the children. Local or regional authorities may take additional steps to ensure the safety of any displaced children. For example, after the 2004 Asian tsunami, the Indonesian government issued a temporary travel moratorium to prevent all children from Aceh Province from leaving the country.³³

Throughout the world, UNICEF establishes Child Protection Centers for children involved in disasters. After the 2006 earthquake in Indonesia, the first such center was operational within three days of the earthquake, providing recreation, hygiene, psychosocial support, and temporary classrooms so that children could continue their education.³⁴

In the event of a US national disaster, the National Emergency Child Locator Center will be operated by the National Center for Missing and Exploited Children to aid in finding missing children and reuniting them with their families.³⁵ When activated, the National Emergency Child Locator Center will:

- Maintain a toll-free hotline to receive reports of displaced children;
- Open a Website to host information about displaced children;
- Deploy staff to obtain information about displaced children;
- Provide information to the public; and
- Partner with law enforcement agencies.

HOUSING, CLOTHING, AND WARMTH

Children who lack adequate warmth, clothing, and housing during a disaster are vulnerable to diseases and stress. The risks are highest for malnourished children who lack subcutaneous fat stores and robust immune systems.

During the movement of displaced people, there may be no alternative to sleeping outdoors at times. In these instances, children should sleep close to parents or siblings in areas that are out of the wind. Priority should be given to using available clothing and blankets for the smallest and most undernourished children. If avail-

able, hay, grass, and/or straw can be used to provide warmth; plastic sheets may be cut into makeshift clothing or blankets to retain body heat, but should be used with caution, and avoided for infants because of the possibility of asphyxiation.

When temporary housing, such as tents, becomes available, priority should be given to children and to nursing mothers. Shelters made of plastic sheeting or canvas and poles can provide useful temporary housing.

PEDIATRIC HOSPITAL SUPPLIES

A survey of more than 700 Canadian hospital emergency departments (EDs) found that: pediatric resuscitation equipment often was not stocked; intraosseous needles were absent in 16% of the EDs; pediatric drug dose guidelines were absent in 7% of the EDs; 10% lacked pediatric defibrillator paddles; and 15% of the EDs did not stock infant blood pressure cuffs.³⁶ On-site inspections of some of the hospitals revealed that the pediatric equipment on hand in the departments was even less than the information the hospitals submitted in their written surveys.³⁶ During a disaster, patients (including children) come to the closest, most accessible hospital, regardless of that hospital's stated pediatric capabilities.²⁷ Therefore, all hospitals need to stock sufficient quantities of supplies to care for children in a disaster setting.

Emergency supplies needed to care for pediatric patients include pediatric sizes of the following equipment:

- Intubation equipment (handles, blades, endotracheal tubes, oropharyngeal airways, and bag-valve-masks);
- Intravascular catheters;
- Intraosseous needles;
- Cervical collars and immobilization equipment;
- Oxygen masks/cannulae;
- Thoracostomy supplies, including chest tubes;
- Blood pressure cuffs; and
- Ventilators.

Other supplies to be kept on hand include: pediatric-size hospital gowns; supplies for distraction/recreation activities (e.g., coloring books, crayons); various size diapers; and infant formula. To prepare for a disaster, it is recommended that all hospitals keep a 48-hour supply of pediatric equipment and pharmaceuticals in stock to manage its usual, average number of patients plus an extra 100 pediatric patients.¹

MEDICATIONS FOR PEDIATRIC VICTIMS OF WEAPONS OF MASS DESTRUCTION

Healthcare facilities and EMS also should stockpile medications for children involved in events related to weapons of mass destruction (WMD). The use of the antidotal Mark 1 kit (containing 600 milligrams 2-pam chloride and 2

milligrams atropine) in pediatric victims exposed to nerve agents and organophosphates has been controversial. However, an atropine intramuscular autoinjector, AtroPen®, is available in four doses of atropine (0.25 milligram, 0.5 milligram, 1.0 milligram, and 2.0 milligram) for pediatric patients exposed to nerve agents and organic phosphates. The US Federal Drug Administration's weight-based recommendations for AtroPen® dosing are listed in Table 17.3.³⁷ Each dose may be repeated up to three times, as needed.

CHILD'S WEIGHT	ATROPEN® DOSE
< 7 kg	0.25 mg
7–18 kg	0.5 mg
18–41 kg	1.0 mg
> 41 kg	2.0 mg

Table 17.3: Recommended doses of Atropen® according to a child's weight³⁷ (kg = kilogram; mg = milligram)

It is recommended that the Mark 1 kit auto-injector be used in dire circumstances only in children >3 years of age or >13 kilograms in weight.¹³ Expert consensus is that, with a verified nerve agent exposure, the benefits of the medications outweigh the risks in circumstances in which precise dosing by weight is not possible.¹

In a disaster involving the release of radiation, all persons (including children) within 10 miles (6 kilometers) of the incident should be given potassium iodine (KI) tablets to protect the thyroid gland against radioactive iodine. If possible, this should be administered within two hours after the event; after 12 hours, there almost is no benefit from KI administration. However, children may not be able to swallow the tablet, and crushing the tablet and mixing it with water creates an unappealing, salty drink that often is refused by the pediatric population. Mixing the crushed KI tablet with juice or milk makes it more palatable to children.³⁸

US FEDERAL PEDIATRIC RESOURCES

Within the United States, there are federal pediatric resources that may respond to a disaster. The US Department of Homeland Security currently oversees two pediatric Disaster Medical Assistance Team (DMAT) units that can deploy to a site within 24 hours, and maintain full capabilities without resupply for 72 hours of operation.³⁹ The federal government also maintains the Strategic National Stockpile of pediatric supplies, such as antiviral medication, which can be deployed within 12 hours of a federal request.¹³

CONCLUSION

The number of children who experience disasters, both from natural and man-made events, has increased dramatically over the past two decades. Children may suffer both acutely and for an entire lifetime because of physical and psychological injuries experienced in disasters. The psychological and/or behavioral responses of children will vary depending on their age, developmental stage, and temperament. Relief workers must provide basic needs to children in ways that are appropriate to their ages. They need to re-establish routines for children as soon as possible, including the provision of culturally appropriate games and activities. Children are not simply “little adults”. Disaster preparedness should accommodate children in the disaster plan and should anticipate the special issues and needs of all children.

MANAGEMENT OF DISASTERS: FOCUS ON CHILDREN AND FAMILIES

In 1996, The Rainbow Center for Global Child Health and Case Western Reserve University developed a training program on “Management of Disasters: Focus on Children” to address the special needs of children affected by disasters in international settings.⁴⁰ This week-long course focuses on global disasters, and attempts to simulate actual problems encountered that relate to children. This course has been offered in Cleveland, Ohio, every summer and adaptations of it have been offered at 15 critical sites throughout the world within the last few years.

Physicians and nurses from Khon Kaen University in northeastern Thailand participated in the course and, with the assistance of faculty from the Rainbow Center, replicated their training back in Thailand in 2001. When the Asian tsunami struck southern Thailand in 2004, these program graduates from the Khon Kaen Schools of Nursing and Medicine were among the first child health professionals available to assess and treat children who had lost their parents as a result of the tsunami.⁴¹ In addition, they developed programs in many schools and villages to help the children, as well as teachers and other caretakers; they continue to follow these children to the present time.⁴² After the earthquake in Pakistan in 2005, the trained Thai faculty also went to Pakistan to participate in four courses on disaster management, focusing on children and families. Most recently, they have shared their experience, knowledge, and information with colleagues in the Solomon Islands following the April 2007 tsunami. To date, thousands of healthcare professionals have been trained in addressing the special needs of children in disasters through this program. Information about problem-based training courses to help children in disasters is available on its Website (www.childrenindisasters.org) or by e-mail at felichatel@yahoo.com.

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CHAPTER 18

REGIONAL PLANNING

Douglas Havron

THE EVACUATION OF THE GULF COAST and other areas of the US Texas coastline during the threat of Hurricanes Katrina and Rita in 2005 presented a logistical response nightmare. Throughout the states, hospitals were overwhelmed, Emergency Medical Services (EMS) units were limited, and evacuation times were prolonged because local jurisdictions and private healthcare systems were operating independently of each other. Much of the confusion was secondary to the communications and response strategies of private systems, including nursing homes, hospitals, and home healthcare providers. The loss of the healthcare infrastructure proved to be catastrophic following the levee breaks of New Orleans, the United States,¹ and from the direct impact of Hurricane Andrew in Florida, the United States.² Additionally, during Hurricane Rita, the assets needed to execute the evacuation mission did not exist in the state of Texas.

OBJECTIVES:

- Identify the key team members of a regional planning team;
- Describe the regional planning components; and
- Understand the value and importance of a regional planning approach to providing for disaster healthcare needs.

Hazardous events and their associated disasters have little regard for the boundaries of local jurisdictions and present serious challenges, regardless of their etiology.³ When the impact is focused on a single community, and local medical services become overwhelmed or non-functional, healthcare workers in communities from the immediately surrounding region must respond. When the impact is spread throughout several communities and impairs the ability of neighboring communities to respond, regional response may become inadequate

and require multi-county assistance and resources from further away, e.g., other states, countries, intergovernmental agencies (IGOs), or non-governmental agencies (NGOs).

Regional planning attempts to involve all essential stakeholders within an area in cooperative disaster preparedness; the geographical scope of the region involved must be clearly described. Regional planning may refer to community planning, county-wide planning, state/province-wide planning, or multi-state/province planning. On a global level, countries may cooperate to develop multi-country regional planning (as has occurred in Southeast Asia following the tsunami) to share resources and response plans for countries in that region. Thus, regional planning comprises various geographical possibilities that must be defined precisely in the disaster plan.

Regional planning helps to ensure that resources potentially needed to provide an effective disaster response to a defined region are in place and prepared to be deployed in a well-coordinated effort. These efforts augment prevention, preparedness, response, and recovery, as described in the US National Response Framework.⁴ Regional response can be planned at a community level, county/parish level, state or province level, country level, or a global level. Discussion in this chapter will focus on regional planning from the state or nearby-state response level.

Typically, the community's local elected officials have the primary responsibility for the community's emergency responses and, thus, must understand the importance of and fully support emergency planning and preparedness. Nurse leaders play key roles in the multidisciplinary, cross-jurisdictional approach essential to disaster preparedness planning. Nurses, with their unique skill sets and knowledge of the community healthcare assets, should be intricately involved in both the immediate local response and the regional response to ensure that the needs of the community are met during a disaster. Many professional nursing agencies have begun to publish additional materials for this purpose, including statements by the Agency for Healthcare Research and Quality (AHRQ),⁵ the American Nurses Association (ANA),⁶ and the Emergency Nurses Association (ENA).⁷

HEALTHCARE INVOLVEMENT

Regional planning requires the coordination of a variety of disciplines in order to maximize the available resources and optimize the disaster responses. Regional disaster planning and responses have developed with the recognition of emergency management as a specialty and have been managed through various state-level entities, e.g., State Emergency Management Committee in the state of New South Wales, Australia. Historically, nurses and healthcare agencies have not been included in regional planning efforts,

partly because they were not responsible for the health and medical care of the entire jurisdiction, and because hospitals have been viewed as the end point of a disaster response rather than as integral to its response. However, this is beginning to change, as evidenced by an increased focus on EM functions within the healthcare accrediting organizations.

In 2005, the US Gulf Coast region experienced the devastating effects of Hurricane Katrina during which hospitals and other healthcare facilities became incident sites, and hospital personnel became victims, as well as healthcare providers. Those experiences illustrate the need for hospitals, nursing homes, dialysis centers, and other healthcare facilities to be part of the disaster response and intricate partners with local, state, and Federal disaster planning, preparedness, response, and recovery initiatives. In some instances, nursing leaders can serve as catalysts to ensure that all of these partners are included in disaster planning activities in order to provide a broad and robust emergency management plan (EMP) for the community.

The establishment of a Healthcare Preparedness Council is one way of bringing private, governmental, and non-governmental healthcare agencies together with traditional EM planners to ensure adequate healthcare representation in all regional disaster planning efforts. Some communities also have Local Emergency Planning Committees (LEPC) that are established forums for disaster planning discussions and can be utilized as a platform for healthcare planning. However, often these committees are specific to a small jurisdiction, a specific threat, or a particular hazardous substance.

REGIONAL PLANNING TEAM

Regional planning begins with the assembly of the appropriate team members with representation from the stakeholders of the community. An appointed regional planner, public health expert, EM expert, government leader, or Ministry of Health (MOH) representative may lead the regional planning effort. In communities without an established medical planner for the region, it may be a nurse leader who organizes the appropriate team to address the regional response healthcare needs. One challenge is that many nurses and physicians feel that they lack the knowledge needed to serve in the disaster response; and medical experts with emergency/disaster management expertise are rare. The Houston, Texas, mega-shelter operations following Hurricane Katrina encountered many responders who were not educated in responses of this type.⁸

The team members of a regional emergency management plan should include, but not be limited to: the traditional first responders (e.g., police, fire, EMS, EM, and hazardous materials [HaZmat] teams); local and regional municipality representatives; public health officials; area healthcare facility leaders or planners; and representatives from any local chapters of response

agencies (e.g., the Red Cross and the Salvation Army). Other members may include representatives from area schools, shelter organizations, donation management organizations, and volunteer agencies including non-governmental and governmental agencies.

Incorporating a healthcare component into regional disaster planning requires knowledge of the medical community in order to identify and include the appropriate healthcare partners. Hospitals, nursing homes, dialysis clinics, community medical clinics, and physician offices may be impacted in a disaster, either by direct damage or by an influx of patients who typically seek healthcare at the nearest healthcare facility. Additionally, the healthcare workers may be needed to staff these locales, based on approved credentials, or be asked to assist in points of distribution (POD), field hospitals, or triage sites. Nursing homes should be included in regional healthcare planning as damage to their facility or a lack of personnel or supplies can result in the need for evacuation of their facility with a resultant impact on area hospitals. Alternatively, nursing homes may receive an influx of patients transferred from nearby affected hospitals.⁹ Dialysis centers must remain operational during a disaster; this requires planning in order to maintain services and patient transportation capabilities. Additionally, medical equipment suppliers (e.g., home oxygen suppliers and vendor-managed inventory systems) must be involved in regional disaster planning to ensure the continuity of care and delivery of needed supplies to impacted individuals and facilities.

Initial healthcare partners involved in regional planning should include representatives from:

1. EMS;
2. Area hospitals;
3. Community medical care centers;
4. Nursing homes;
5. Dialysis centers;
6. Medical equipment suppliers;
7. Volunteer medical organizations; and
8. Public health

Additionally, regional hospital associations and related healthcare professional organizations (e.g., Boards of Pharmacy, Nursing, and Physicians) might be involved in regional disaster planning and response.

REGIONAL PLANNING COMPONENTS

Hazard Vulnerability Assessment

Although an “all-hazards” approach should be incorporated into all disaster planning,¹⁰ identifying the more probable threats to the community through a hazard vulnerability assessment (HVA) (Appendix 18A) can drive proper

prioritization in planning, mitigation, response, and recovery efforts. By identifying likely hazards and vulnerabilities, the HVA provides the regional planning team guidance on its approach to health care during a disaster. This assessment should be done in collaboration with local emergency managers, public health, and other subject matter experts previously mentioned. The estimated probability of the risks of certain hazards is based on past statistical data, historical trends, and/or other known hazards. The planning team should approximate the risk of each hazard taking into account the financial impacts, legal implications, possible damage, injuries or death, overall impact on health, and factors related to the interruption of routine services. Lastly, planners must approximate the jurisdictional preparedness for each identified hazard, including evaluation of current preparedness plans, educational levels, redundant systems, and other regional resources. Each of these estimates is used to calculate a score for each hazard, thereby determining, in a more objective manner, the region's priorities.¹¹

Incident Command Systems

Without clear objectives, oversight, and an organized reporting structure, regional response and recovery efforts can become complicated and unorganized with numerous agencies working independently and, at times, counter-productively. An Incident Command System (ICS) is useful to ensure effective communication, to identify the key response positions and their immediate responsibilities, and to define a clear chain of command. Moreover, it is necessary to ensure the adequate and appropriate distribution of limited resources. The regional planning team should develop the methods for a regional response and encourage their practice during drills and exercises. To ensure effective flow of information, hospitals and other responding agencies should utilize an integrated ICS that interfaces with the region. (See Chapter 10.) Throughout Texas, as directed by the governor, regions are instructed to create a "Regional Unified Command Structure (RUCS), and appoint a single Incident Commander for the Regional Unified Command Structure."¹²

Asset Distribution

In a widespread disaster, multiple agencies compete for the same assets at the same time. To ensure that assets are distributed in the most appropriate manner according to the highest priority needs, and to maximize the resources of multiple hospitals and healthcare systems, regional efforts must be directed toward establishing a system for coordination and prioritization. An array of near real-time software applications have been implemented following recent large-scale disasters and preparedness grant funding. These include asset tracking systems for medical supplies, ambulances, and pharmaceuticals, to name a

few. Additionally, states are implementing systems for reporting and tracking all available patient beds, in an attempt to identify potential surge capacity.

Nurses and other healthcare providers can provide valuable clinical expertise regarding the coordination of hospital beds, the determination of appropriate patient placement, and early evacuation and triage during a large-scale crisis. The use of a regional healthcare coordinating center recently has emerged as a way of addressing these regional response issues by using clinicians and real-time reporting technology to appropriately match a patient's symptoms or mechanism of injury with the healthcare facility having the capability and capacity to best care for that patient. This necessitates non-traditional EMS transports to specialty facilities and the triage of and treatment within these specialty facilities.¹³ The responses to Hurricane Katrina demonstrated the applicability of such a center in addressing acute nursing care needs, environmental food/health safety needs, inoculations, syndrome surveillance, and quarantine implementation.¹⁴

Mass Care

Regional plans for mass healthcare must address pre-hospital care, acute care, hospital-based care, alternative care sites, decontamination ability, mass prophylaxis, palliative care, pandemic preparedness, mass fatality, mass-casualty management, refugee centers, and legal/ethical considerations. While nurses and other healthcare workers receive specific training in each of these areas, combining all of these types of patients in a single area can be complicated. Thus, specific actions must be taken to attempt to meet the needs of everyone, understanding that in large-scale incidents, priorities of care will have to be established.

Regional planning also involves creating systems for handling mass-care issues that cannot reasonably be provided by individual healthcare facilities because of financial, jurisdictional, or physical issues. Regional planning for community alternative care sites includes determining the location, negotiating usage terms, and defining the staffing responsibilities of each area healthcare facility, if applicable. For instance, staffing options for the alternative care site might include plans for each hospital within the immediate area to supply several healthcare providers to supplement the alternative site staff; or the site may be staffed entirely from hospitals outside of the disaster-impacted area, or by volunteer medical providers.

Hospitals, often operating within tight financial constraints, may be unable to finance and implement all the resources needed for an optimum response to the variety of potential catastrophic events that could impact the community. Regional planning for mass care involves creatively using these limited finances and supplies to provide a regional response structure that could be used by any requesting hospital. For instance, regional Disaster Medical Assistance Teams (DMATs), comprised of staff and supplies from pre-identified agencies, could be

organized for the purpose of responding to an area in need. Additionally, regionally-placed assets, such as pandemic flu supplies, could be stockpiled by regional emergency management or the MOH and delivered, as needed, to the hospitals bearing the heaviest impact. This forward movement of assets (i.e., moving supplies to areas in which they are needed) is becoming common in regional emergency and disaster planning.

Emergency Operations Center

An emergency operations center (EOC) is used at the regional level to facilitate and unify the coordination of available resources within all the response agencies involved in the event. (See Chapter 10 for a detailed discussion of the role of the EOC.)

Credentialing

After events such as the Oklahoma City bombing, 9/11, and the numerous hurricanes of 2005, many states within the United States have initiated pre-creden-

THE LONZ WINERY DISASTER: REGIONAL PLANNING OF AIR AMBULANCE SERVICES

The necessity for air ambulance services is not limited to mega-disasters, such as Hurricane Katrina or the Indian Ocean tsunami; they are valuable adjuncts in most local or regional mass-casualty incidents. On 01 July 2000, the terrace of the historic Lonz Winery in Middle Bass Island, Ohio, USA, collapsed with more than 100 people falling more than 20 feet (6 meters).¹⁴

As with most island communities, emergency medical resources are limited on all of the islands in Lake Erie, including Middle Bass Island. Previously established links facilitated the timely notification of three air ambulance services located in northwest Ohio and southeast Michigan. Within minutes of the call, the first medical helicopter arrived at the island. Over the course of the next hour, air ambulance services from Cleveland Metro Health, St. Vincent's Medical Center, and the Coast Guard Air Station in Detroit, Michigan made multiple sorties, transporting the most critically injured, performing life-saving interventions, and ferrying additional personnel and equipment. Of the 75 persons injured, air ambulances transported 28 critically injured victims to Trauma Level-1 medical centers in Toledo and Cleveland, Ohio. This was accomplished in the face of significant operational difficulties, such as a dysfunctional cellular telephone network, overwhelming radio traffic, incompatible radio frequencies, limited equipment (requiring doors and wooden planks to be used as backboards), and an anxious, inebriated, and disruptive civilian contingent.^{16,17}

Paul Rega

tialing of health professionals as a priority issue in regional planning. Pre-credentialing allows for rapid verification of a responder's skill sets as well as verification of the identity of the arriving responder. Within the United States, the Emergency System for Advanced Registration of Volunteer Health Professionals (ESAR-VHP) standard was established by the Health Resources and Services Administration (HRSA) for state implementation. Each state's system is developed to permit the fast and easy exchange of health professionals' credentialing information. The ESAR-VHP system eliminates the traditional, time-consuming steps involved in assessing each volunteer's capabilities, and streamlines the verification process so that state EM and medical operations personnel can quickly allocate the most appropriate human assets to the region affected.

Mutual-aid Agreements

Mutual-aid Agreements are pre-established plans created to lend response assistance across jurisdictional boundaries, where such sharing otherwise may be limited. During an emergency, these agreements allow for the sharing of assets, both human (personnel) and physical (supplies and equipment). Many times, these arrangements are established through formal memoranda of agreements (MOAs). A MOA is a legal, binding document holding both agencies loyal to the written specifications of the agreement. Pre-established arrangements also may be made through a written memorandum of understanding (MOU) that acknowledges a willingness of parties to work toward a common goal or mission.

The mechanisms used to provide the needed assistance may vary by state or locale. Regional EMS and fire departments have been operating successfully with such mechanisms for many years. However, the idea of sharing personnel, supplies, and equipment between potentially competing healthcare facilities is not as formalized or widely accepted in other arenas. Nonetheless, recent catastrophic events have begun to change this ideology. State health departments, as well as nursing leaders, play key roles in the facilitation of these agreements through planning mechanisms.

The US Emergency Management Assistance Compact (EMAC) was established in 1996 as a result of various experiences from all types of hazards within the United States. Coordinated by the National Emergency Management Association, EMAC provides mutual aid between all 50 states and US territories. The EMAC offers fast assistance through these mutual agreements by providing state-to-state assistance of human or physical assets, thereby increasing response capabilities during Governor-declared emergencies.

Practice Standards

State nursing leaders and state health departments should work together to educate the nursing community and clarify nursing care expectations during

each type of potential disaster declaration. As an example, during evacuations, nurses may be asked to care for patients in mass-transit vehicles or ambulances; certainly unfamiliar environments for most hospital-based nurses. Furthermore, in cases of hospital infrastructure loss due to disruption of services (e.g., due to utility outages, or flooding) or structural damage (e.g., due to tornadoes, earthquakes, or acts of terrorism) nurses may be required to work in precarious conditions.

Certain mutual-aid agreements, Good Samaritan laws, and emergency statutes may offer liability protection to responders. However, liability protection differs among situations, jurisdictions, states, and nursing professions. It is essential that nurse responders understand the policies of their institutions and act in accordance with all imposed regulations. In some instances, nurses and other healthcare providers may be classified as non-paid or temporary employees. In the United States, individuals who function in an unpaid, professional role are eligible for liability coverage and worker's compensation under the US Federal Tort Claims Act. However, healthcare providers need to clearly understand and seek guidance related to liability and negligence surrounding the elements of duty to act, breach of duty, causation, and damages. Healthcare workers and organizations need a clear understanding of their role during a disaster response, as it may be impacted by a hospital/healthcare organization's liability.

REGIONAL PLAN ACTIVATION

Each jurisdiction will have specific individuals who are responsible for and authorized to activate response plans. These may be elected officials (judges, mayors, etc.), EM coordinators, or public health officials. In officially declaring an emergency, jurisdictional administrators evoke certain powers that are not normally in place and, in some cases, lift some existing stringent policies. This may involve the closure of schools, the appropriation of assets, or the restriction of public access to certain affected areas. These powers allow the jurisdiction to have a broadened legal infrastructure and purchasing power, the ability to acquire goods/services, as necessary, and other emergency enactment authority. Additionally, a formal emergency declaration may lift specific laws previously in place. Healthcare facilities may not be required to report certain patient diagnoses, as they normally would. For example, in the United States, state requirements for patient transfers between hospitals normally are more lenient during an emergency evacuation process, allowing for the sharing of patient health information, as needed.¹⁵

A state may enact a general emergency or a public health emergency declaration; the reason for doing so is dependent on the event and its consequences. For example, damage related to hurricanes, wildfires, or earthquakes

may generate emergency disaster declarations from EM officials; whereas, disease outbreaks related to contaminated water, pandemic flu, or food-borne contamination outbreaks may necessitate public health emergency declarations. General emergency and public health emergency declarations can be made independently or concurrently. It is essential that nurse responders understand the impact of these declarations and the effects upon their practice, specifically, the impacts upon licensed professionals relative to changes in their normal practice or usual standards of care. In some cases, the declarations may pose conflicting expectations, which can occur when state and federal regulations differ; or when practicing in another state under a mutual-aid agreement. This is specifically a concern when certain powers and resources are coordinated by different offices, depending on the emergency. For example, during the response and recovery phases of disasters from natural causes or human-caused incidents, processes typically are coordinated by the Office of Emergency Management, while in public health emergencies they are coordinated by state health departments and public health authorities. Nurse leaders within each state must be involved and active in the disaster planning phase to identify potential conflicts and describe explicit plans and expectations for these situations. Individual nurses should be aware of any practice regulations that may vary among disciplines and jurisdictions, and follow the guidance provided by their professional licensing agency.

During times of non-declared emergencies, agencies within a jurisdiction should work to develop agreements regarding defined responsibilities. Some states have developed pre-established powers that will be lifted or implemented during certain declarations. In contrast, other jurisdictions have chosen to provide powers to certain governmental leaders who will make decisions once presented with the specific problem or challenge.

CONCLUSION

Many recent disasters have demonstrated that rarely is only one local community or jurisdiction affected. Disasters affecting single communities, as well as those affecting widespread areas, often require a regional response to properly address the impact on healthcare services. Regional planning for healthcare ensures needed resources are in place and delivered in a well-coordinated effort.

Regional planning may begin with local elected officials, but a diverse team is required to address all of the emergent needs of the community. Nurse leaders, with their unique skills and knowledge of the community, must be a part of regional disaster planning and response in order to ensure that the health needs are met and that the impacted community has a positive outcome.

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Appendix 18A: Health Vulnerability Assessment (Available at www.fema.gov/business/guide/section1b.shtm)

1	2	3	4	5	6	7	8
Type of Emergency	Probability Impact	Human Impact	Property Impact	Business Impact	Internal Resources	External Resources	Total

- In the first column, list all emergencies that could affect your facility or community. Consider:
 - The local history of events (fire, hurricanes, severe weather, hazardous material incidents, etc.);
 - The geography of your location (proximity to seismic faults, flood plains, nuclear power, etc.);
 - The technological systems that could cause a system failure (power failure, explosions, telecommunications failure, etc.);
 - Human error (employee fatigue, substance abuse, etc.);
 - Physical causes (construction issues, combustibles, hazardous processes or products, etc.); and
 - Regulatory issues (hazards or emergencies you are regulated to manage).
 Analyze each potential emergency considering the impact of: prohibited access to the facility; loss of electric power; loss of communication; ruptured gas lines; water/smoke/structural damage; air/ water contamination; building collapse; trapped victims; explosions; and chemical releases.
- In the second column, estimate the Probability of the occurrence of each type of emergency listed using a 1 to 5 scale, where 1 = the lowest probability, and 5 = the highest probability.
- In the third column, estimate the Potential Human Impact of each type of emergency (i.e., the possibility of death or injury) using a 1 to 5 scale, where 1 = the lowest impact, and 5 = the highest impact.
- In the fourth column, estimate the Potential Property Impact (i.e., losses and damages) for each type of emergency using a 1 to 5 scale, where 1 = the lowest impact, and 5 = the highest impact. Consider costs to repair, replace, or set up temporary replacement.
- In the fifth column, estimate the Potential Business Impact for each type of emergency. Consider employee effects, materials/supplies effects, interruption of services, legal costs, etc.
- and 7. In the sixth and seventh columns, respectively, estimate the Internal and External Resources impact for each emergency using a 1 to 5 scale, where 1 = the lowest impact, and 5 = the highest impact. For each type of emergency ask: Do we have the needed resources and capabilities to respond? Will external resources be able to respond to us as quickly as we may need?
- In the eighth column, total the scores from each column for each type of emergency. The lower the total score, the less vulnerable is the assessed facility/community/region.



CHAPTER 19

US FEDERAL RESOURCES AND RESPONSE

Alan D. Cohn and J. Bennet Waters

TO PREVENT, prepare for, respond to, and recover from terrorist attacks, major disasters, and other emergencies, the United States Government shall establish a single, comprehensive approach to domestic incident management. The objective of the United States Government is to ensure that all levels of government across the Nation have the capability to work efficiently and effectively together, using a national approach to domestic incident management. In these efforts, with regard to domestic incidents, the United States Government treats crisis management and consequence management as a single, integrated function, rather than as two separate functions.”

Homeland Security Presidential Directive #5¹

The United States faces the prospect of events — whether naturally occurring or deliberately caused — that may threaten its security, disrupt its economy, and imperil its citizens. Moreover, we know that despite efforts to prevent and protect against such events, their occurrence is inevitable. Disasters from natural causes (such as

OBJECTIVES:

- Understand the mechanisms for implementing a US federal response to disaster events;
- Describe the role and function of the National Response Framework; and
- Describe the major components of the National Disaster Management System.

Authors' Note: All information in this chapter was current as of July 2009, and all embedded hyperlinks were verified on 30 July 2009. However, the US federal government maintains a very active posture with regard to disaster preparedness, planning, response, and recovery. As a result, the structures, responsibilities, plans and associated documents (and particularly those maintained online) are highly dynamic and change frequently. Readers are encouraged to use the information in this chapter as a baseline for general concepts, disaster response doctrine, and the distributed responsibilities and structures for domestic incident management. When possible, the authors have provided hyperlinks for readers to access additional or updated information as it becomes available.

wildfires, earthquakes, floods, tornados, and hurricanes as well as human-caused events, such as oil spills, hazardous materials releases, and industrial accidents, are facts of life that occur periodically. Within the United States, the events of 11 September 2001 and the anthrax attacks that followed serve as stark reminders of the vulnerability to intentional attacks instigated by those who aspire to harm that nation. The emergence of viruses, such as West Nile and Severe Acute Respiratory Syndrome (SARS), as well as the current threat of an H1N1 pandemic influenza, pose distinct, but related, challenges. Other threats might include: attacks using chemical, biological, radiological, nuclear, or high-energy explosive weapons; cyber attacks; accidental failures in critical infrastructures, such as power plants and water systems; as well as other infectious disease outbreaks or unforeseen catastrophic events.

Because of the often unpredictable nature of events that can cause a disaster, it is imperative that the United States has a robust architecture for preparedness and response. This chapter will provide an overview of the United States' framework, plans, resources, and allocation of responsibilities for responding to the medical consequences of a disaster.

RESPONSE PLANNING

Incident management responsibilities extend across all levels of government and all segments of society. No single entity alone can effectively prevent, protect against, respond to, and recover from an incident that is of sufficient size, scope, or complexity to require a national response. Rather, the successful response will involve individuals, communities, private sector businesses, and non-governmental organizations (NGOs) as well as governmental organizations at all levels. A brief summary of roles and responsibilities of each of these entities follows.²

Individuals and Families

National emergency and disaster preparedness begins with individuals and families, who must learn about the hazards in their area, develop family emergency plans, and prepare emergency supply kits. Individuals and families with special needs must identify those specific services and supplies that they will require in an emergency. By being better prepared, individuals and families can improve their outcome and reduce the need for government support immediately following an event.

Community, Private Sector Business, and Non-governmental Organizations

Citizens play an essential role in guarding and protecting their communities against hazards through neighborhood watch programs, police auxiliaries, and volunteer fire departments and ambulance squads. In addition, more than 85%

of the United States' critical infrastructure facilities and key resources are owned and operated by private sector businesses. As a result, the private sector almost certainly will be affected by a disaster. Potential roles private businesses may play during a disaster include being: (1) the regulated or responsible party for a facility affected by or at the center of an event; (2) a response resource either on a donated or contracted basis; or (3) partners with state, local, territorial, or tribal emergency organizations. Some activities in which private businesses and organizations may be involved include:

1. Supporting incident management by sharing information;
2. Identifying risks;
3. Performing vulnerability assessments;
4. Developing emergency response and business continuity plans;
5. Enhancing the overall disaster readiness of their business or organization;
6. Implementing appropriate prevention and protection programs; and
7. Donating goods and services or providing them through contractual agreements or government purchases.

NGOs, including faith-based organizations, offer routes of volunteer service for interested individuals. Non-governmental organizations and voluntary organizations provide relief services to sustain life, including specialized services that help individuals with disabilities, reduce physical and emotional distress, and promote the recovery of disaster victims. These organizations work closely with first responders, all levels of government, and other organizations.

Local Government

Police, fire, public health, medical, emergency management, public works, environmental response, and personnel from other sectors may be among the first to detect a threat, arrest a suspect, or respond to an emergency, and often are the last to leave an incident site or to otherwise deal with the effects of an incident. Mutual-aid agreements among regional health services and organizations provide mechanisms to mobilize and employ resources from neighboring jurisdictions to support the incident responses. Pre-arranged and formalized mutual-aid agreements are essential components of community preparedness.

State Government

As a state's chief executive, the governor is responsible for the public safety and welfare of the people of that state. The governor coordinates state resources to address the full spectrum of actions needed to prevent, prepare for, respond to, and recover from events of all types. The governor also serves as the commander-in-chief of state military forces (e.g., the National Guard, when performing

active duty on behalf of the state, or if activated by the governor under Title 32 and any other authorized state militias) and requests federal assistance when it becomes clear that state or tribal capabilities will be insufficient or have been exhausted. State EM agencies coordinate activities statewide to respond to major incidents, and state law enforcement organizations work in partnership with federal and local law enforcement agencies to prevent terrorism and to protect the people and the state infrastructure.

Federal Government

The federal government plays a variety of roles in incident management. For incidents that largely impact areas of state, local, territorial, and tribal responsibilities, the federal government provides support upon request of the Governor of the affected state. For incidents implicating primary federal jurisdiction or authorities, federal agencies may be the first responders. In either case, federal departments and agencies work with each other and with state, local, territorial, and tribal governments, non-governmental organizations, and the private sector to manage incidents effectively.

Timelines

The responses to a disaster begin immediately at the local level. Traditional emergency responders (police, fire, emergency medical services, and other public safety professionals) provide the initial responses to virtually all events. These responders' plans must include preparation for 48–72 hours of continued activities as interstate mutual-aid assets and federal government resources typically do not begin to arrive and augment the local response for 48–72 hours. Local jurisdictions also may request assistance from regional or state authorities, who may meet these requests through regional response agreements, or interstate arrangements such as the Emergency Management Assistance Compact (EMAC). (The availability and responsiveness of mutual-aid assets will vary based on distance, the complexity of efforts required to deliver them, the impact of the event on mutual-aid partners, etc.)

In most cases, a federal response will be initiated by a request from the affected state's governor and takes approximately 48 hours to attain full strength. However, for certain types of major disasters (e.g., disasters caused by large hurricanes, earthquakes, and acts of terrorism), the federal response begins immediately and automatically with assets deployed according to the *National Response Framework*.

NATIONAL RESPONSE FRAMEWORK (NRF)

The Homeland Security Presidential Directive-5 (HSPD-5), issued by the president in 2003, outlined roles, responsibilities, and presidential authorities

MEDICAL RESERVE CORPS

Launched in July 2002, the Medical Reserve Corps (MRC) (www.medicalreservecorps.gov) was created as a way for local communities to identify, organize, train, and utilize medical, public health, and other volunteers to meet public health needs throughout the year, and during times of emergency. The mission of the MRC is to improve the health and safety of communities across the country by organizing and utilizing public health, medical, and other volunteers.

In the aftermath of 9/11 and the subsequent anthrax mailings, the complexities of utilizing volunteers to support a public health response became immediately apparent. Credentialing and liability issues, as well as the lack of a system to manage and supervise the spontaneously arriving, unaffiliated volunteers resulted in the turning away of many skilled volunteers.

As of March 2007, the MRC has grown to include >645 units in all 50 US states. MRC volunteers with a broad-range of expertise and skill sets are utilized to meet the needs of the local community. The volunteers' professional categories include physicians, nurses, pharmacists, veterinarians, and many other types of medical and public health workers, as well as individuals with no healthcare experience who help with administration, communications, logistics, and other essential functions. MRC members may be in active practice or retired.

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for domestic incident management. This directive designated the Secretary of Homeland Security as the principal federal official for domestic incident management. For the first time in US history, a single cabinet official was given the consolidated responsibility for domestic incident coordination. As the principal federal official, the Secretary of Homeland Security was designated to act as the agent of the President, the National Security Council, and the Homeland Security Council with lead responsibility for overall incident management and coordination of federal operations.

The HSPD-5 also directed the Secretary of Homeland Security to develop a *National Response Plan* (NRP) and a National Incident Management System (NIMS).³ The *Federal Response Plan*, the *US Government Interagency Domestic Terrorism Concept of Operations Plan*, and other existing federal plans, as well as the Incident Command System, provided the initial strategic approach to coordinated incident management. Over the subsequent years, the federal government has published a variety of additional plans, directives, and guidance addressing elements of the homeland security and the incident management continuum.

EMERGENCY SUPPORT FUNCTIONS	DEPARTMENT(S) WITH PRIMARY RESPONSIBILITY
ESF 1 – Transportation	Department of Transportation
ESF 2 – Communications	Department of Homeland Security
ESF 3 – Public Works and Engineering	Department of Defense/US Army Corps of Engineers Department of Homeland Security/FEMA
ESF 4 – Firefighting	Department of Agriculture/Forest Service
ESF 5 – Emergency Management	Department of Homeland Security/FEMA
ESF 6 – Mass Care, Housing, and Human Services	Department of Homeland Security/FEMA American Red Cross
ESF 7 – Resource Support	General Services Administration
ESF 8 – Public Health and Medical Services	Department of Health and Human Services
ESF 9 – Urban Search and Rescue	Department of Homeland Security/FEMA
ESF 10 – Oil and Hazardous Materials Response	Environmental Protection Agency Department of Homeland Security/ US Coast Guard
ESF 11 – Agriculture and Natural Resources	Department of Agriculture Department of the Interior
ESF 12 – Energy	Department of Energy
ESF 13 – Public Safety and Security	Department of Homeland Security Department of Justice
ESF 14 – Long Term Community Recovery and Mitigation	Department of Agriculture Department of Commerce Department of Homeland Security/FEMA Department of Housing and Urban Development Department of the Treasury Small Business Administration
ESF 15 – External Affairs	Department of Homeland Security/FEMA

Table 19.1: Emergency Support Functions (ESFs) and the federal departments bearing primary responsibility (FEMA = Federal Emergency Management Agency)

In 2007, the Department of Homeland Security issued the *National Response Framework* (NRF) as the successor document to the *National Response Plan*. Building on the myriad documents preceding its publication, the *National Response Framework* has become the backbone document upon which US domestic incident response is built.

When an affected state's resources are overwhelmed, its governor may request federal assistance. The NRF provides the coordinating principles for federal operations responding to the state's request for assistance. A primary tenet of the NRF is that the federal government, when responding to a state's request for assistance, acts in support of the state and does not usurp the state's sovereignty. The NRF provides a structure within which to marshal the resources of all federal departments and agencies in support of the state,

with different federal departments and agencies coordinating various aspects of the response through 15 Emergency Support Functions (ESFs) (Table 19.1).

The *National Response Framework* describes the doctrine and core principles for domestic incident management. Building on the National Incident Management System, the NRF describes the roles, responsibilities and federal, state, local, and field-level structures involved in domestic incident coordination. As noted above, the *National Response Framework* relies on Emergency Support Functions annexes that identify the primary and support agencies responsible for each support function. The NRF also includes support annexes that describe functional processes and associated administrative requirements and incident annexes that describe specialized, incident-specific situations. Each incident annex identifies a primary agency that has responsibility for incident-specific planning and the development of incident scenario “playbooks”. These primary agencies-of-responsibility lead the federal government’s response for that particular support function. The support agencies include other federal departments or agencies that share a common mission or can provide a service necessary for the completion of the specific support function. The primary agency of responsibility ensures that the Emergency Support Function’s response objectives are met through the combined actions

ESF 8 — PUBLIC HEALTH AND MEDICAL SERVICES	DEPARTMENT OF HEALTH AND HUMAN SERVICES RESPONSIBILITIES	SUPPORT AGENCIES
	• Assess public health and medical needs • Health surveillance • Medical care personnel • Medical equipment/supplies • Patient evacuation • Patient care • Safety of drugs/devices • Blood products • Food safety • Agricultural safety • Worker health/safety • Public health support • Behavioral health • Public health/medical information • Vector control • Potable water/waste disposal • Victim identification/mortuary services • Animal health protection	• Agriculture • Defense • Energy • Homeland Security • Interior • Justice • Labor • State • Transportation • Veterans Affairs • Environmental Protection Agency • General Services Administration • US Agency for International Development • US Postal Service • American Red Cross

Table 19.2: Department of Health and Human Services responsibilities and support agencies for ESF 8 — Public Health and Medical Services (Support agencies listed as US departments)

of the primary and support agencies. In the field, the Federal Coordinating Officer, who is a senior Federal Emergency Management Agency executive designated by the President in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act, coordinates the ESF activities and ensures that the various federal departments and agencies are appropriately integrated in their missions. The Secretary of Homeland Security provides overall coordination for all federal prevention, protection, response, and recovery operations.

The Department of Health and Human Services (HHS) is the primary agency responsible for Emergency Support Function 8 Public Health and Medical Services. ESF 8 has 15 support agencies, ranging from the Department of Defense, which supplements the austere medical care capabilities of the HHS and provides a range of other functions (airlift, medical material and personnel, logistical support) to the General Services Administration, which, as the contracting arm of the federal government, supports ESF 8 in contracting for goods and services necessary for the provision of health care. The primary agency's responsibilities and the support agencies available for public health and medical services (ESF 8) are listed in Table 19.2.

RESOURCES

National Disaster Medical System⁴

The National Disaster Medical System (NDMS) is a cooperative, asset-sharing program among federal government agencies, state and local governments, private businesses, and civilian volunteers. In domestic incidents, the NDMS functions as part of ESF 8 under the *National Response Framework*. Administratively, the NDMS is housed in the Office of Preparedness and Response in the US Department of Health and Human Services.

The overall purposes of the NDMS are to establish a single integrated national, medical response capability for assisting state and local authorities in dealing with the medical and health effects of major peacetime disasters, and to provide support to the military and Veterans Health Administration medical systems in caring for casualties evacuated back to the United States from overseas armed conflicts. With respect to domestic incidents, the NDMS is designed to ensure that resources are available to provide medical services during a disaster that overwhelms the local and state healthcare resources. Operating under the principles of the National Incident Management System and within the framework of the *National Response Framework*, National Disaster Medical System assets are activated through the Emergency Support Function #8 desk at the National Response Coordinating Center and, when deployed, are coordinated by the Federal Coordinating Officer.

The two main functions of the National Disaster Medical System are:

1. Medical responses to a disaster area in the form of teams, supplies, and equipment; and
2. Patient evacuation from a disaster site to participating hospitals in unaffected areas of the nation where patients can obtain definitive medical care.

Teams

The National Disaster Medical System (NDMS) includes several different types of specialized medical teams; currently, there are 104 teams. All NDMS team members are required to maintain applicable certifications and professional licenses within their disciplines. When NDMS team members deploy, their professional licenses and certifications are recognized by all states. Team members are paid as part-time or intermittent federal employees, and have liability protection under the Federal Tort Claims Act. A brief summary of each type of team follows.

Disaster Medical Assistance Teams (DMATs)

Disaster Medical Assistance Teams (DMATs) are groups of professional and para-professional medical personnel that provide health care during a disaster or other event in which medical needs exceed the resources available. Each DMAT has a commander and a command staff that recruits members, arranges training, and coordinates the deployment of the team. Currently, there are 54 DMATs in the United States. In addition, there are specialty DMATs trained and equipped to deal with specific medical conditions, such as pediatric injuries and illnesses, burns, and mental health emergencies.

The DMATs are designed to be rapid-response supplements to local medical care until other federal or contract resources can be established, or until the situation is resolved. The DMATs deploy to disaster sites with sufficient supplies and equipment to provide medical care at a fixed or temporary medical care site, and to sustain themselves (including food and housing) for a period of 72 hours, after which time they will be re-supplied through normal Emergency Support Functions logistical support systems. Mission activities, which are established in collaboration with state and local officials, can include:

1. Establishing a triage treatment facility;
2. Replacing or augmenting a damaged emergency department (ED);
3. Augmenting staff in a facility where personnel have been impacted by a disaster;
4. Augmenting staff for specialty care (burn, critical care, pediatrics, etc.);
5. Establishing special needs shelters;

6. Operating immunization or mass vaccinations clinics;
7. Performing medical needs assessment to determine where medical resources are needed;
8. Providing medical coverage for national special security events; and
9. Supporting patient reception and the forward movement of patients.

International Medical Surgical Response Teams (IMSuRTs)

The National Disaster Medical System maintains three International Medical Surgical Response Teams (IMSuRTs) located in the eastern, western, and southern regions of the United States. The IMSuRTs differ from DMATs in that they are capable of establishing free-standing surgical field facilities anywhere in the world. The IMSuRTs may be used for both domestic and international response.

National Nurse Response Teams (NNRTs)

National Nurse Response Teams (NNRTs) are specialty teams used in response to an incident requiring a surge of nurses to assist in chemoprophylaxis, mass vaccinations, or other incidents that overwhelm the local nursing resources. The NNRTs are directed by the National Disaster Medical System in conjunction with a Regional Team Leader who is a regular member of an NNRT and serves as a link to the NDMS headquarters, ensuring synchronicity in NDMS objectives and regional NNRT operations across each of the 10 federal regions in the United States.

The NNRTs consist of approximately 200 nurses who: (1) are required to stay current in treatment recommendations for injuries and diseases compatible with weapons of mass destruction; (2) complete web-based training courses in disaster response, humanitarian relief, bioterrorism, and other relevant training; and (3) participate in regular training exercises.

The National Pharmacy Response Teams (NPRTs)

National Pharmacy Response Teams (NPRTs) also are located in each of the 10 federal regions of the United States, and are used to assist in chemoprophylaxis or mass vaccination programs. NPRT members must: (1) complete web-based training programs; (2) stay current in treatment recommendations for injuries and diseases compatible with weapons of mass destruction; (3) participate in training; and (4) be available to participate in training and deployments.

Veterinary Medical Assistance Teams (VMATs)

Veterinary Medical Assistance Teams (VMATs) provide assistance in assessing

the extent of disruption and the need for veterinary services following major emergencies or disasters. These responsibilities include: (1) assessment of the medical needs of animals; (2) medical treatment and stabilization of animals; (3) animal disease surveillance; (4) zoonotic disease surveillance and public health assessments; (5) technical assistance to assure food and water quality; (6) hazard mitigation; and (7) animal decontamination.

The VMATs are composed of clinical veterinarians, veterinary pathologists, animal health technicians (veterinary technicians), microbiologists/virologists, epidemiologists, toxicologists, and various scientific and support personnel.

Disaster Mortuary Operational Response Teams (DMORTs)

Disaster Mortuary Operational Response Teams (DMORTs) provide forensic identification of disaster victims and assist local medical examiners with the disposition of human remains. Their capabilities include: (1) victim identification; (2) forensic dental pathology; (3) forensic anthropology methods; (4) processing of remains; and (5) preparing remains for burial or other disposition. The DMORTs are composed of funeral directors, medical examiners, coroners, pathologists, forensic anthropologists, medical records technicians and transcriptionists, finger-print specialists, forensic odontologists, dental assistants, x-ray technicians, mental health specialists, computer professionals, administrative support staff, and security and investigative personnel.

The National Disaster Medical System maintains two Disaster Portable Morgue Units with caches of mortuary equipment and supplies for deployment to a disaster site. These units contain a complete morgue with designated workstations for each processing element, and prepackaged equipment and supplies.

Management Support Teams (MSTs)

Deployed National Disaster Management Teams are supported by a Management Support Team. In addition to providing administrative and logistics support, Management Support Teams serve as an interface between the NDMS teams, local incident management structures, and the Joint Field Office.

Federal Coordinating Centers (FCCs)

In addition to deployable teams, the National Disaster Medical System is responsible for the operation of the Federal Coordinating Centers (FCCs), which recruit hospitals and maintain local non-federal hospital participation in the NDMS. In certain types of disasters, it may be advisable and/or expedient to evacuate patients away from the disaster location rather than to deploy medical assets into the disaster area. (For example, a nuclear event likely would contaminate a region's healthcare facilities, thus making it necessary to move patients to other non-contaminated areas.) In such circumstances, the FCCs play an impor-

tant role in coordinating the movement of patients.

If and when it becomes necessary to move victims out of a disaster area, National Disaster Medical System personnel provide immediate care and stabilization at the disaster site until such time as the victims can be airlifted to a tertiary care facility. Under most circumstances, the Department of Defense will provide aeromedical evacuation under the coordination of the Global Patient Movement Requirements Center (GPMRC) which is a unit of the US Transportation Command based out of Scott Air Force Base in Illinois.

Working through the FCCs, and subject to availability, hospitals may agree to commit a number of their acute care beds for patients from the NDMS.

Participation in this program is voluntary and, upon activation of the system, hospitals may provide more or fewer beds than the number originally committed in the agreement. Hospitals that do admit NDMS-transferred patients are guaranteed financial reimbursement by the federal government.

Upon receiving a mission assignment from the Federal Emergency Management Agency, the Department of Defense will activate the Global Patient Movement Requirements Center (GPMRC), which will deploy its Immediate Response Assessment Team for situational awareness in the field. Upon receiving patient information from the Immediate Response Assessment Team, the GPMRC then tasks the Federal Coordinating Centers with determining bed availability among the NDMS member hospitals. The GPMRC coordinates air operations and tracks patient movement to ensure a safe, orderly flow of patients from the disaster site to the receiving NDMS air stations. Once patients arrive at the NDMS-receiving airfield, they “will be met by a local medical team that will sort, assess, and match those patients to participating hospitals, according to procedures developed by local authorities and the local area’s NDMS FCC. Patients will be transported to participating hospitals using locally available ground and air transport.”⁵

In addition to the above, and when not involved in actual patient movement, the Federal Coordinating Centers coordinate exercises and emergency plans with participating hospitals and other local authorities in order to develop patient reception, transportation, and communication plans. Additional information regarding the Federal Coordinating Centers is available on the NDMS Website at www.hhs.gov/aspr/oepo/ndms/join/index.html.

Additional Medical Response Resources

In addition to the National Disaster Medical System, the Federal government either maintains directly or provides tools for states and local governments to maintain other specific medical resources. Brief descriptions of several such resources follow.

Strategic National Stockpile (SNS)

The Strategic National Stockpile (SNS) is maintained by the Department of Health and Human Services' Centers for Disease Control and Prevention. The SNS contains large quantities of pharmaceuticals and medical supplies to augment local and state resources in the event of a large-scale public health emergency. Such events could include a disaster from a natural event (e.g., a severe hurricane, earthquake, or outbreak of pandemic influenza) or from a deliberate terrorist event. Additional information regarding the SNS is available at www.bt.cdc.gov/stockpile/.

The US Public Health Service Commissioned Corps

The Commissioned Corps of the US Public Health Service (PHS) is “an elite team of more than 6,000 well-trained, highly qualified public health professionals dedicated to delivering the nation’s public health promotion and disease prevention programs and advancing public health science.”⁶ The Commissioned Corps consists of physicians, nurses, pharmacists, dentists, dietitians, engineers, environmental health officers, health services officers, scientists, therapists, and veterinarians. To augment local, state, and federal responses to the medical and public health consequences of catastrophic events, the PHS has developed the Commissioned Corps Readiness Force (CCRF), which is a deployable component of the Commissioned Corps. The CCRF is comprised of “a cadre of PHS officers, uniquely qualified by education and skills, who can be mobilized in times of extraordinary need during disaster, strife, or other public health emergencies and in response to domestic or international requests to provide leadership and expertise by directing, enhancing, and supporting the services of the PHS and other DHHS OPDIVs [operating divisions], other US government agencies, and/or other respondents.”⁷ These Commissioned Corps officers, all of whom have normal duty assignments within the PHS, are organized into Rapid Deployment Force teams capable of rapidly mobilizing to a disaster site and augmenting local, state, or Federal responders in providing a broad range of medical and public health support services, ranging from primary public health measures (such as vaccinations) to complex tertiary care of the sick and injured.

Federal Medical Stations (FMS)

The Department of Health and Human Services maintains a series of deployable Federal Medical Stations to provide non-acute medical, mental health, and observational care to patients whose needs cannot be accommodated in general shelters. Federal Medical Stations are maintained under the auspices of the Health and Human Services Assistant Secretary for Preparedness and Response, and typically are staffed by National Disaster Medical System personnel

or by deployed members of the US Public Health Service Commissioned Corps Readiness Force.

Emergency System for Advanced Registration of Health Professions Volunteers (ESAR-VHP)

The events of 11 September 2001 highlighted the need to establish standardized, state-owned information systems by which volunteer health professionals could be better utilized following a large-scale disaster. In 2002, US Congress established the Emergency System for Advanced Registration of Volunteer Health Professions (ESAR-VHP). Through ESAR-VHP, individual states develop registration systems to maintain verified, up-to-date information about resident medical volunteers, including: identity; contact information; license, credentialing and accreditation status; and active privileges in hospitals or medical facilities in their home state. Originally part of the Health Resources and Services Administration, the ESAR-VHP program now is coordinated by the Department of Health and Human Services' Assistant Secretary for Preparedness and Response.

US Military

The US military possesses and maintains a wide variety of deployable medical assets, ranging from small teams of medical professionals to full-scale combat support hospitals. In those instances in which military assets are required to support civilian and other federal resources in responding to a large-scale disaster, these assets are requested, engaged, and deployed through the mechanisms outlined in the *National Response Framework*.

CONCLUSION

The United States embraces a response doctrine that reflects a flexible, scalable, and adaptable approach to incident management. Building on the principles of the National Incident Management System and incorporating the response architecture outlined in the *National Response Framework*, the United States leverages the strength of individuals and families, communities, private sector businesses, non-governmental organizations, local and state governments and the federal government to respond to a disaster.

The *National Response Framework* sets out the US response framework. At the federal government level, the Emergency Support Function structure integrates the capabilities of multiple federal departments and agencies. Emergency Support Function 8 (ESF-8) focuses the resources of the federal government for public health and medical response. Within ESF-8, the National Disaster Medical System serves as the organizational structure for medical response teams of all types. In addition to the National Disaster

Medical System, the US government maintains additional medical response resources and marshals the efforts of volunteer healthcare providers.

Within this structure, there are vast resources available to assist governments and other entities that are impacted by disaster. Moreover, there are myriad opportunities for medical professionals to register, train, prepare for, and participate in organized response activities following catastrophic incidents. Finally, regardless of one's role in responding to a disaster — as a responder, volunteer, or impacted entity — it is imperative that roles and responsibilities are understood before an event occurs. The Federal Emergency Management Agency offers online training courses for the *National Response Framework* and National Incident Management System at www.fema.gov/emergency/nims/nims_training.shtm. These courses provide comprehensive information for responders at all levels and can enhance one's understanding of the players, resources, and organizational structures that can be engaged in re-responding to the medical consequences of a large-scale disaster.

DMAT RESPONSE 2004

Hurricane Charley caused severe structural damage to the Charlotte Regional Medical Center in Florida, the United States, in August 2004. South Florida's DMAT-5 was deployed and within one hour after their arrival had set up a mobile emergency department.⁸ The hospital's Emergency Department was then closed for repair and all patients subsequently were seen in the DMAT's tents.

During their 11 days of operation, the DMAT team saw more than 1,000 patients with chronic conditions and traumatic injuries. Among the challenges were continuing antibiotic therapy for home patients in the community, and coordinating replacement of oxygen tanks with local vendors for patients on home oxygen therapy.

Robert Powers

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CHAPTER 20

INTERNATIONAL DISASTER RESPONSE

Susan M. Briggs

“WORKING OVERSEAS is like playing a game (or several at once) which you don’t fully understand and for which the rules have not been explained very well.”

Adaptation of a Robert Kohl quote

INTERNATIONAL DISASTERS INCLUDE large-scale disasters from natural events, such as earthquakes and tsunamis, as well as man-made events, such as war, terrorism, and technological incidents. Natural and human-generated events resulting in international disasters, both unintentional and intentional, are increasing in frequency and severity. Today, disasters from natural events are even more devastating due to numerous factors such as explosive population growth, urbanization, poverty, and increasing economic and social disparities.¹ Armed conflicts increasingly involve civilians, especially vulnerable populations, such as children and the elderly. All of these factors greatly increase the challenges of international disaster relief.

OBJECTIVES:

- Describe the four aspects of international disaster response;
- Understand the interrelationships of the various response organizations and their roles; and
- Understand the challenges to providing relief work in disaster conditions.

All international disasters, regardless of their etiology, have similar medical and public health consequences.^{2,3} A consistent approach to disasters, based on an understanding of their common features and the response expertise they require, is becoming the accepted practice throughout the world. This strategy is called the mass-casualty incident (MCI) response, and is especially important in international disaster response.²⁻⁴

The complexity of today's international humanitarian crises has increased the need for multidisciplinary medical and public health specialty teams as critical assets in international disaster relief. Current disaster planning and response emphasizes the need for an "all-hazards" approach. Flexibility and mobility are the key assets required of all international disaster management teams. International disaster teams may be generic healthcare teams based on professional certification (physician, nurse, etc.) or specialty teams designed to address a specific area of clinical expertise (functional capacity) needed to meet the needs of disaster victims (trauma, critical care, burns, search and rescue, etc.). The concept of disaster healthcare teams based on "functional capacities" (i.e., the role they will play) or clinical competencies is becoming increasingly important in international disaster relief due to the fact that there are numerous organizations from many countries involved in the response, with multiple languages spoken by team members and victims.^{4,5} Countries also have differing medical systems, and the matching of teams with similar clinical competencies eliminates redundancy.

THE RESPONSE

Although medical and public health concerns are present in every disaster, international disasters differ in the extent to which the medical and public health infrastructures of the affected region are disrupted by the disasters. The severity and diversity of injuries, in addition to the number of victims, are major factors in determining whether an international disaster requires resources from outside the affected nation.

Activation

The activation of international disaster response teams can occur in a number of ways. Generally, the affected country requests assistance via the government officials of foreign countries already in the country; for example, US aid is requested through the US embassy located in the country affected by the disaster. Other organizations (such as the United Nations (UN), the North Atlantic Treaty Organization, and the European Union) also may forward requests for assistance to their member countries.

The US International Medical Surgical Response Teams (IMSuRT) are ready for deployment within six to eight hours of activation to provide medical and surgical care wherever needed. However, transportation assets often limit the actual response times of this volunteer civilian team. A review of previous disaster responses suggests that the most effective use of search and rescue teams is within the first 72 hours, mandating that teams in close proximity to the country affected by the disaster be utilized primarily.

Aspects of Response

Healthcare concerns related to international disaster response include the following four aspects: (1) search and rescue; (2) triage and initial stabilization; (3) definitive medical care; and (4) evacuation.

Search and Rescue

The local population near the disaster site comprises the initial, immediate search and rescue resource. In disasters involving large numbers of victims trapped in collapsed structures, the local response may lack the necessary equipment and expertise for extraction. Many countries have developed search and rescue teams as an integral part of both their national disaster plan and international response capacity.⁶⁻⁸ These teams receive specialized training in working in confined space environments. Evidence exists that emphasizes the need for search and rescue teams to be deployed within the first 24 hours, particularly during a mass-casualty disaster resulting from an earthquake.⁹ Search and rescue units generally include:

1. A cadre of healthcare specialists (physicians, nurses, medics);
2. Technical specialists knowledgeable in hazardous materials, structural engineering, heavy equipment operation, and technical search and rescue methods; and
3. Trained canines and their handlers.

Triage and Initial Stabilization

Triage is the most important mission of any disaster medical relief response effort. In international disasters, the primary triage of victims is performed by



Photo courtesy of Susan Briggs

Figure 20.1: Rescue workers attending to victims of the railway bombing in Spain

responding personnel from the affected country. International relief teams may be called upon to triage patients with pre-existing medical conditions (e.g., dehydration, cardiac or pulmonary conditions) that have been exacerbated or neglected as a result of the disaster or traumatic injuries with delayed manifestations (e.g., crush injury/syndrome, compartment syndromes, or infections) (Figure 20.1).^{9–12}

Definitive Medical Care

Definitive medical care generally refers to care that will improve, rather than simply stabilize, a casualty's condition. Requirements for definitive medical care in international disasters vary widely depending on the epidemiology, magnitude, and geographical location of the disaster.

In many international disasters, local hospitals/clinics may be destroyed, transportation to medical facilities may not be feasible, and/or the environment may be contaminated. In these situations, definitive care must be provided outside of traditional medical facilities. International teams with mobile equipment (field hospitals and supplies) that can provide a graded, flexible response to the need for definitive medical care in disasters are key to a successful international disaster response.^{9,13,14} Teams must be configured to care for routine emergencies (obstetrics, pediatrics, and cardiac, etc.) as well as injuries related to the hazardous event. International relief teams must be totally self-sufficient and not a burden to an already overwhelmed medical and public health infrastructure. Although the provision of definitive care is the key mandate for international disaster teams, often these teams do not reach the disaster region for days after the event due to logistical constraints.¹⁵

Evacuation

The evacuation of victims often is a necessity in international disasters, especially in austere environments. Indications for evacuation from a disaster site are:

1. The need to decompress the disaster area;
2. The need to improve care for the most critical casualties by removing them to off-site medical facilities (secondary triage);
and
3. The need to provide specialized care for specific casualties, such as those with burns and crush injuries.^{2,12}

Key Concepts of Response

Incident Command System

Both medical and public health disaster responses are coordinated through the Incident Command System (ICS). (See Chapter 10 for a detailed discussion of

the ICS.) In an international disaster, the Incident Commander usually is the UN or a designated local government official from the affected region. Ideally, international disaster response teams are configured to provide a functional role in disaster response (i.e., provide the specific need requested) so as to effectively coordinate with other international teams. Focusing on functional types of disaster medical responses ensures that teams with specific clinical competencies (i.e., pediatrics, primary care, trauma surgery, etc.) are matched to the specific medical needs of disaster victims. This facilitates a coordinated ICS in international disasters, and minimizes the deleterious effects of language barriers in providing disaster care.

CASE STUDY: BAM, IRAN, EARTHQUAKE, DECEMBER 2003

A major earthquake measuring 6.5 on the Richter scale struck Bam, Iran, on the morning of 26 December 2003. The earthquake killed >40,000 people, injured 30,000, and left approximately 75,000 persons homeless (Figure 20.2). Bam's healthcare facilities were nearly 100% destroyed, and 50% of the healthcare personnel were dead or missing. No local healthcare facility was functional. Humanitarian assistance was provided by approximately 60 countries and consisted of: 35 search and rescue teams; 26 medical and public health assistance teams; 12 international field hospitals; seven logistical teams; five assessment teams; and one telecommunications team.^{8,15}



Photo courtesy of Susan Briggs

Figure 20.2: The rubble that remained of victim's houses following the Bam, Iran earthquake in 2003

International disaster teams must be totally self-sufficient (water, food, fuel, shelter, etc.) so as not to further burden the affected country. Often the medical mission is not well-defined until the teams arrive at the disaster site. Keys to a successful international disaster response are flexibility and mobility. Multidisciplinary teams are most valuable to the affected country due to their ability to care for both disaster-related injuries as well as provide emergency medical and surgical care for non-disaster-related illnesses. Primary care, pediatrics, and obstetrics are healthcare specialties needed in all international disasters, regardless of etiology.

INTERNATIONAL DISASTERS: THE PLAYERS

Traditionally, international humanitarian relief has been thought of as providing comprehensive assistance (food, water, shelter, sanitation, health care) for victims of disasters from natural events, such as earthquakes, tsunamis, and hurricanes. However, international disaster teams increasingly respond to disasters from man-made and war-related events, often termed *complex humanitarian emergencies*, due to the increased level of complexity in providing assistance in politically insecure environments and catastrophic public health emergencies (epidemics, bioterrorism, etc.).^{1,3,5}

Generally, major participants in international disaster relief are part of the United Nations organizations, international organizations, governmental organizations, non-governmental and private voluntary organizations, or military organizations.

United Nations (UN) Organizations

The United Nations (UN) pursues the attainment of basic human rights for all people, including the provision of health needs during complex emergencies and disasters. The UN's Office for the Coordination of Humanitarian Affairs (OCHA) chairs the Inter-Agency Standing Committee (IASC), which coordinates humanitarian responses, and whose members include representatives from key UN agencies, international organizations, and non-governmental response agencies. The UN agencies represented in this committee include the UN High Commissioner for Refugees (UNHCR), the World Health Organization (WHO), the World Food Program (WFP), and the UN International Children's Fund (UNICEF).

The UNHCR leads and coordinates international responses to refugees and ensures that refugees have their basic rights met, including food, shelter, and medical care. The UNHCR has 278 offices in 111 countries. Its responses have included the Balkans in the 1990s, as well as ongoing work with the refugees in Sudan. As of early 2007, the UNHCR had identified 32.9 million people of concern — a 56% increase from the previous year.¹⁷

The *World Health Organization* (WHO), through its Health Actions in Crisis (HAC) program, serves as the health arm of the UN in response to crises. To reduce death, disease, and disability from crises, the HAC works with UN member states to strengthen medical capacity and response systems prior to a disaster or crisis, to coordinate and integrate response agencies during a disaster, and to assist with efficient recovery.

The *World Food Programme* (WFP) provides immediate food and basic supplies in refugee crises. The WFP works with the UN Emergency Assessment Teams to determine assistance needs and relies on donations to fulfill these needs. The WFP is the world's largest humanitarian agency with a presence in 77 countries. In 2003, the WFP delivered 6 million tons of food to 110 million people.¹⁷

The *United Nations Children's Fund* (UNICEF) provides emergency assistance to children affected by disasters focusing on interventions needed to save the lives of, protect, and ensure the rights of children. The agency works with local and international partners to establish emergency immunization programs, feeding centers, supplies of drinking water, tracing and reunification programs, as well as support programs to assist children with emotional and mental health problems.

International Organizations

International organizations, such as the International Committee of the Red Cross (ICRC) and the International Federation of Red Cross and Red Crescent Societies (IFRC), have a long history of disaster responses. The ICRC is a neutral, independent organization mandated through the Geneva Conventions to protect lives and provide humanitarian assistance. Other ICRC activities include promoting humanitarian law and tracing missing persons in times of war and disaster. The ICRC maintains a permanent presence in more than 60 countries.¹⁸

The IFRC coordinates large-scale relief work among the 185 national Red Cross and Red Crescent societies and their 97 million volunteers throughout the world. The IFRC organizes Emergency Response Units consisting of personnel and equipment that can be operational within a week, with a four-month deployment capability. These Emergency Response Units, which are on standby in Europe, consist of 3 to 20 team members with various specialty expertise, and including logistics, relief, information technology and telecommunications, basic health care as well as a field hospital unit with a 120–150 bed capacity.¹⁸

Governmental Organizations

Various countries maintain funding agencies dedicated to international relief and development during and following disasters. These include the US Agency for

International Development (USAID), Australia's AusAID, and the UK's Department for International Development. In addition, governments have a number of organizations with a mandate for providing international disaster responses.

In the United States, the Department of Health and Human Services (HHS) often provides specialized assistance in international disasters. The National Disaster Medical System (NDMS), currently under the auspices of the HHS, provides international disaster medical assistance through the IMSuRTs. These teams are volunteer teams federalized under the auspices of HHS. Each of the IMSuRT teams is sponsored by an academic trauma center (Massachusetts General Hospital – Boston, Ryder Trauma Center – Miami, and Harborview Medical Center – Seattle), and are designed to provide the full spectrum of health care, including surgical procedures, for victims of mass-casualty incidents, especially in austere environments. The teams are composed of 35 members with mobile equipment and supplies, including pharmaceuticals, blood, and a mobile field hospital. This cache permits patient triage and initial stabilization, definitive surgical care, critical care, and evacuation capacity at both fixed and mobile hospital facilities.¹⁶ Nurses are an integral part of the teams and participate in all aspects of disaster healthcare.^{8,10}

Other agencies within the US Department of HHS, such as the Center for Disease Control and Prevention (CDC) and the Public Health Service, provide specific “functional” expertise in international disasters.

Canada's Disaster Assistance Response Team (DART) includes a 40-person medical team capable of caring for 250 outpatients/day. Although it cannot provide surgical intervention, the DART unit also has an engineering unit capable of setting up refugee camps and improving access to health care by repairing roads.¹⁹

Other governmental response organizations include the Japan International Cooperation Agency's Japan Disaster Relief Teams (discussed in Chapter 21) and Australia's developing Disaster Medical Assistance/UCT Teams. Almost all countries have some element of a disaster response team, but too often, they are focused only on one aspect of medical care and are not equipped to meet non-disaster-related medical needs, especially those of pediatrics and obstetrics.

Non-governmental and Private Voluntary Organizations

Non-governmental organizations (NGOs) and private voluntary organizations (PVOs) are the primary implementers of international disaster assistance. Hundreds of organizations — small and large, local, regional, and international, religious and secular — provide a wide range of expertise to meet medical and public health concerns of disaster victims, including food, nutrition, shelter, water and sanitation, health, and human rights.^{1,3} Some prominent NGOs include: Doctors without Borders; Save the Children Alliance; World Vision International; and Relief International.

AUSTRALIAN RESPONSE TO 2004 SOUTHEAST ASIA TSUNAMI

The Australian Defence Force provided the earliest Australian assistance to the 2004 Southeast Asia tsunami. Operation Sumatra Assist provided:

- 1,200 tons of humanitarian aid supplies delivered by C-130 aircraft;
- 70 aero-medical evacuations;
- Air transportation of 2,530 people;
- 3,700 medical treatments at field hospital;
- 17.8 million liters of clean water;
- Clearing of 9,000 cubic meters of debris; and
- Clearing of 1,700 large drains.²⁰

Robert Powers

Non-profit organizations that advocate for policy include Project Hope and the American Refugee Committee. Increasingly, for-profit organizations, professional organizations, and consultants participate in international relief, further complicating the challenges of a unified incident command structure.

Military Organizations

The military often plays a role in disaster responses. Both the US military and the Australian Defence Forces (ADF) provided logistical and medical support during the 2004 Asian tsunami, including operation of the 1,000-bed US Naval Hospital Ship Mercy for six weeks, and the ADF's Operation Sumatra Assist, which provided airborne humanitarian aid, transported victims, and provided medical care to the tsunami victims. The disaster relief effort on the US Naval Hospital Ship Mercy was a coordinated effort between the US Navy, Project Hope, and US academic centers. Canada's Disaster Assistance Response Team (DART) consists of 200 Canadian forces and has been deployed to Turkey, Pakistan, and Sri Lanka to render assistance to victims of earthquakes and the earthquake/tsunami.

The role of the military in disaster relief continues to be controversial and varied, depending on the country. Some military units responding to disasters are not designed to provide the full, multi-disciplinary spectrum of medical care. Additionally, the presence of the military during complex humanitarian crises sometimes can compromise the response team's attempts to maintain neutrality and may jeopardize the mission and, potentially, the safety of the team. Nonetheless, military assets are vital in providing the critical security, communications, and logistic operations necessary in international disaster relief. Without such support, medical and public health teams often cannot fulfill their missions. A major challenge for the future is better coordination between military and civilian disaster assets.

CHALLENGES TO RESPONSE

Environmental

Many of today's international mass-casualty incidents occur in austere environments, i.e., locations where aspects of the political, social, physical, or economic environment impose severe constraints on the adequacy of international disaster healthcare responses. The provision of sophisticated health care in an austere environment is a challenge for all healthcare providers. Physical and political environments, in particular, often impose distinctive burdens and demands on all members of the international disaster team. The physical environment often is a major challenge to effective disaster medical responses. Many international disasters, especially earthquakes, occur in remote regions making it difficult to transport personnel and supplies to the region in a timely manner. Often, political constraints imposed by organizations or the government of the affected country limit the utilization of all medical assets in the most effective manner.

Terrorism

Terrorism presents a special challenge for disaster response teams. Terrorists do not have to kill people to achieve their goals; they simply have to create a climate of fear and panic to overwhelm the healthcare system.² Terrorism is designed to generate publicity for the political, religious, or ideological objectives of the terrorist group. The more destructive the event, the greater the press coverage; this is a major factor impacting international disaster responses. Often, press coverage focuses on the sensational aspects of the disaster that may not be the most devastating medical aspects of the disaster.

Disasters involving weapons of mass destruction (nuclear, biological, and chemical) are one of the greatest challenges for international disaster responders, whether the incident is unintentional (a chemical spill or a nuclear reactor leak) or intentional (such as the Tokyo sarin attack). Weapons of mass destruction will produce large numbers of casualties and "expectant casualties" (victims not expected to survive due to extensive injuries or limited resources) that will overwhelm the healthcare system of the affected country. Weapons of mass destruction also produce contaminated environments, further complicating international disaster response.^{2,4}

Media

Greater media coverage (the "CNN factor") has provided unprecedented attention to international humanitarian emergencies. Although this attention potentially can mobilize public opinion and international relief, there are significant problems created by the attention afforded some international disasters. As media exposure is key to obtaining donations, many humanitarian organi-

zations increasingly feel pressure to act during a disaster, whether or not action is warranted based on the needs assessment of the affected country/region.

Cultural

Good intentions and clinical expertise do not ensure an effective international disaster response. Pitfalls, especially cultural pitfalls, must be avoided. Intercultural effectiveness is the key to successful international disaster response. Cultural variables impacting on disaster responses include:

1. Ethics;
2. Geography;
3. Social;
4. Work; and
5. Organizational.

International disaster teams may not be cognizant of important ethnic considerations when they initially arrive in the country. For example, countries vary in their acceptance of amputations, “do not resuscitate” practices, and rituals associated with dead victims. Geographical considerations always are a challenge when disasters occur in remote regions, particular in extremely cold or hot environments. Social considerations, particularly in countries whose governments are dominated by religious groups, often are difficult to ascertain immediately. Many religious groups limit medical care provided by members of the opposite sex; this often necessitates reorganization of the infrastructure of the international field hospitals. The relationships and social customs of males and females can be quite challenging for response workers, especially in Muslim countries. International disaster teams generally make no distinction in the type of physical work, the hours worked, and the medical roles between male and female members; however, this practice is not universally accepted and is at odds with the customs of many countries.

One of the more challenging aspects to effective organization and functioning of international disaster teams is the differing political organizations within the country. The inability to communicate effectively often leads to misunderstandings between responders and country government officials, creating unnecessary delays.

Important cultural considerations when responding internationally include:

1. Don’t assume sameness — Monitor your instincts; what is “natural” behavior to you may be culturally unacceptable in this environment. For example, shaking hands between females and males may not be socially acceptable in certain Muslim countries;
2. Behaviors of familiarity may have different meanings and, thus, be interpreted incorrectly;
3. Don’t assume that what you meant is what was understood;

4. Don't assume that what you understood is what was meant;
5. You don't have to like different behaviors, but you need to understand them; and
6. Most people behave rationally; you just have to find the rationale.

Safety

Personal safety is key to all international disaster responses. Not only are the risks to providers not well known in advance, but language barriers often preclude the adequate explanations of risks. It is critical that the ICS and chain of command be followed without exception. Healthcare providers, often used to working independently, may find it difficult to follow directions they do not understand fully. However, pursuing an individual agenda or questioning some of a country's practices and customs may lead to injury, and even death, of providers. Thus, the role of the Safety Officer, a critical position in the ICS, assumes great importance in foreign countries.

CONCLUSION

With their expertise in performing rapid assessment, triage, and the ability to provide definitive, critical, and psychological care, nurses are uniquely qualified to participate in all four aspects of disaster medical response. Health care in international, mass-casualty events often requires substantial modification in content and application when compared with standard approaches used in the responder's native country. The training and supervision of healthcare professionals who aspire to work in these settings must pay explicit attention to these recognized challenges. Healthcare disaster teams must be trained in basic principles of disaster response, such as triage, decontamination, and the ICS if they are to utilize their clinical skills effectively in international disasters. Clinical expertise and good intentions alone will not suffice to achieve the goal of the "greatest good for the greatest number of victims" in international disaster responses.

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CHAPTER 21

DISASTER NURSING RESPONSES IN JAPAN

Satoko Mitani

IN JAPAN, DISASTERS CAUSED BY NATURAL EVENTS occur every year. In 1995, more than 6,400 lives were lost in the Great Hanshin-Awaji earthquake and, currently, there is concern that a large ocean trench earthquake will occur in the East Coast and/or East and South Coast regions of Japan, causing a serious tsunami and widespread damage. Thus, the threat of disasters from major natural events remains an ongoing concern in Japan.

The immense damage caused by the Isewan typhoon in 1959 was a turning point in terms of Japan's national disaster management, prompting a move to establish a national, comprehensive disaster management system and enactment of the Disaster Countermeasures Basic Act in 1961. Since then, Japan's disaster management system has been improved and strengthened following the occurrences of several large natural catastrophes and subsequent disasters. As a result of its experiences and lessons learned from numerous disasters, Japan has developed a number of innovative disaster countermeasures.

OBJECTIVES:

- Describe the Japanese government's system of disaster activation and response;
- Understand the nurses' role within the various Japanese response agencies; and
- Describe the three response agencies different activation mechanisms.

Today, the country actively promotes international cooperation in the field of disaster management in four distinct ways: (1) through technical cooperation, such as providing training courses for specialists from other disaster-prone countries and dispatching Japanese specialists to countries in need; (2) through the granting of disaster aid funds; (3) by providing loans;

and (4) by cooperating on a multilateral level with United Nations (UN) organizations.

In general, responding nurses work to protect the health and safety of the affected people at the disaster sites. In addition, they provide care and support to their relief co-workers, and play an important liaison role in the management of the human relationship aspects of their missions.

GOVERNMENT RESPONSE

In Japan, the Central Disaster Prevention Council, chaired by the Prime Minister, is comprised of the entire Cabinet, including the Minister of the State for Disaster Management, the heads of designated public institutions, and technical experts. This Council is set up in the Cabinet based on the Disaster Countermeasure Basic Act; its functions include:

1. Create and promote the implementation of the Basic Disaster Management Plan;
2. Create and promote the implementation of plans for emergency measures in the event of a disaster;
3. Deliberate disaster preparedness and response following a request from the Prime Minister or the Minister of the State for Disaster Management (e.g., basic policies on disaster management, overall coordination of disaster management measures, and proclaiming an emergency situation); and
4. Provide After-action Reports concerning disaster management to the Prime Minister and the Minister of State for Disaster Management.¹

In the case of an emergency in Japan, the national and local government immediately collect and analyze information on the current status and the extent of damage, and exchange this information with relevant persons and organizations. After their analysis of the situation, the system for executing disaster emergency responses is established. The disaster emergency responses include providing advice or directions regarding evacuation, fighting fires, rescuing victims, securing emergency transportation, and the emergency recovery of public facilities. In municipalities and prefectures in which the disaster occurs, disaster emergency response measures, such as establishing a headquarters for emergency management, are conducted by the municipal government and the prefectural government with full mobilization of their resources. At the time of a large-scale disaster, the government may establish a Headquarters for Major Disaster Management (headed by the Minister of State for Disaster Management) or a Headquarters for Urgent Disaster Management (headed by the Prime Minister) to coordinate emergency measures.

Immediately after the onset of a disaster, the Director Generals of each ministry and agency gather at the Prime Minister's official residence.

Utilizing the information collected from pertinent organizations and images of the disaster-stricken area provided by a helicopter from a related ministry or agency, the amount of damage is estimated using the Early Estimation System (EES). There also are instances in which the government dispatches an investigation team to the stricken area in order to obtain more detailed information.² With this information, reports are made to the Prime Minister so that the appropriate responses can be determined promptly. In a large-scale disaster that exceeds the response capabilities of the local government, the prefectural governor may request disaster emergency response assistance from the National Police Agency, the Fire and Disaster Management Agency, and/or the Japan Coast Guard. Japan's Self-Defense Forces (JSDF) also can be dispatched for emergency response activities.

In 1987, the Japan Disaster Relief Team Dispatch Law was enacted; this law allows and promotes comprehensive international emergency disaster relief activities (e.g., providing relief goods and assistance) through various organizational arrangements. The country's non-governmental organizations (NGOs), such as the Japan Red Cross Society, also are active internationally.

RESPONSE AGENCIES

Japanese disaster relief organizations include the JSDF, the Japan Medical Team of Disaster Response (JMTDR), the Humanitarian Medical Assistance in Japan (HuMA), as well as other disaster response teams, such as the Japanese Red Cross, Médecins sans Frontières (MSF), and the Association of Medical Doctors of Asia (AMDA).

The conditions and the environment of the work of these agencies vary according to the disaster type and to the mission of the particular organization. The impetus to respond also differs according to the organization. The nurses involved in the respective teams may be paid workers or serve in a volunteer capacity.

The Japan Self-Defense Forces

The Japan Self-Defense Forces (JSDF) consist of three distinct defense branches with the common missions of national defense, international contributions, and disaster relief based on humanitarian principles. The three branches of the JSDF include: (1) the Ground Self-Defense Force; (2) the Air Self-Defense Force; and (3) the Maritime Self-Defense Force. Military service in these organizations is voluntary.

Within the JSDF are medical relief teams that may be dispatched to a disaster site to provide: (1) first aid and assistance in the prevention of an epidemic; (2) emergency transportation of personnel, patients, medical resources, and supplies; and (3) loans and disposition of assistance materials.

Although, in principle, the JSDF is dispatched only upon formal request, at times it has responded independently, or as mutual aid to neighboring Self-Defense Force facilities within Japan.

Immediately after the onset of any major disaster with large-scale human and physical damage, units of the Ground Self-Defense Force, the Maritime Self-Defense Force, and the Air Self-Defense Force begin preparation for rescue operations. This occurs either in response to a request by the governor of the affected prefecture(s) or in response to their assessment of the perceived needs. An international medical relief unit of the JSDF may be dispatched to troubled regions based on the Act Concerning Dispatch of Japan Disaster Relief Team.

There are two types of JSDF medical relief teams that can be dispatched to a disaster site. One is a logistical support regiment of medical troops that consists of one medical doctor and 14 medical troops including nurses. The other is a medical relief team that is located within a JSDF hospital. The JSDF has a total of 16 hospitals: eight hospitals within the jurisdiction of the Ground Self-Defense Force; five within the Maritime Self-Defense Force; and three within the Air Self-Defense Force. Each hospital has medical relief teams comprised of one doctor, two nurses, and two other personnel. The JSDF has approximately 60 medical relief teams, plus a logistical support regiment of medical troops, that can be dispatched to affected areas throughout the country at the time of disaster.³

Nurses' Roles

Nurse members of the JSDF are full-time, active, medical troops within the various military branches. Their responsibilities, roles, and activities combine both nursing and troop duties. Their activities are mandated based on national policy and the defined purpose of the particular corps' activities, i.e., to preserve life and property. In the case of a domestic disaster within the country, a request for assistance is formally petitioned by the governor of a prefecture. In the case of international disasters, team deployment is based on decisions of the Diet (parliament) and/or the Act Concerning Dispatch of Japan Disaster Relief Team. The length of deployment varies based upon the need; for example, JSDF nurses served for 19 days at the Hokkaido-Nanseioki earthquake site in 1993, for 101 days at the Great Hanshin-Awaji earthquake site in 1995, and for approximately three months at the Indonesia tsunami disaster site in 2005.

Education

Nurses in the JSDF receive on-the-job training as well as formal lectures and classes. Prior to being dispatched to an area of conflict, nurse troops receive

basic military training, including weapons training. Immediately before a deployment, they also receive information concerning language, local customs, conditions, and endemic diseases of the response area.

Japan Medical Team of Disaster Response (JMTDR)

Japan's disaster relief activities date back to the late 1970s, when medical teams were dispatched to assist Cambodian refugees. In August 1974, the Japan International Cooperation Agency (JICA) was officially established. In accordance with the economic growth of Japan, various cooperative programs were established within the JICA, including the Disaster Relief Program (1987). When major disasters occur, the JICA's Disaster Relief Program dispatches a Japan Disaster Relief (JDR) team to provide emergency relief supplies, in response to a formal request. This request may come from the government of the affected country or from international agencies in accordance with the Act Concerning Dispatch of Japan Disaster Relief Team. Depending on the need, JICA's Disaster Relief Program dispatches rescue teams, medical teams (i.e., the Japan Medical Team of Disaster Response [JMTDR]), and other expert teams to provide emergency supplies and material assistance. The JICA also actively develops alliances with related organizations in order to facilitate the swift implementation of relief services at the disaster site. The JICA cooperates with Japanese NGOs operating in affected areas in order to implement and supplement operations.⁴

Medical services provided by the JMTDR in affected areas include the diagnosis, treatment, and care of victims, and, when necessary, infection prevention and containment. The team is composed of 21 members, with a Command Chief who is an official in the Foreign Ministry, an Associate Command Chief who is a physician and the designated leader of the medical team, three other doctors, a chief nurse, six additional nurses, four medical coordinators, and four operational coordinators. Medical Coordinators support medical activities (such as the management of medical charts, the reception and management of patients, and interventional assistance), which includes the activities of radiological technicians and clinical technologists. Operational coordinators provide the management of materials and equipment, team management, arrangement of interpreters, procurement and distribution of material supplies, accounting, publication, recording, security measures, communication and coordination with relevant organizations, and information gathering.

Nurses' Roles

As members of the JMTDR, nurses are responsible for the administration of medical supplies, including their distribution and organization, requests for procurement of items, and the handling of medical equipment. Nurses per-

form health interview assessments and triage disaster victims. Additionally, they assist physicians in diagnostic and medical examinations, and perform wound care, blood drawing, and transfusions, as needed. They instruct patients regarding medication dosage and administration, and other healthcare activities. They also interview victims regarding health problems, the extent of damage to their property and livelihood, and identify appropriate social support services; based on this information, they undertake appropriate nursing interventions. Although the activities are not substantially different from those of their usual nursing practice, the limitations inherent in a disaster setting may make it difficult to perform their accustomed nursing practices.

As members of the medical team, nurses fulfill multiple nursing and non-nursing activities, as needed. For example, their responsibilities may include the transportation of equipment and materials, the setting up of treatment sites, and food preparation/delivery, in addition to health care and management of team members, safety management, and team building.

Education

All members of the JMTDR receive the same three-day introductory training program. Thereafter, each member can elect to take specific one-day training courses to enhance their disaster response abilities. This education is classified according to three topics: nursing skills, nursing methodology, and nursing practice. *Nursing skills* include physical assessment, wound management, and bandaging. *Nursing methodology* includes understanding the decision-making process involved in such team decisions as: (1) deployment; (2) site determination for set-up; (3) set-up issues; (4) action plans; and (5) exit strategy. *Nursing practice* was added as a component of the training courses in 2006.

Potential Problems

Members of the JMTDR are registered volunteers from throughout the country who must be able to work together in a team for a period of two weeks. Thus, their personality, their ability to cooperate, and their ability to function with autonomy are critical to team cohesiveness. As volunteers, team members must obtain prior approval from their hospital supervisor to take leave of their duties for a two-week period, when needed. This issue may make it difficult for some individuals to participate in JMTDR's relief work.

Humanitarian Medical Assistance in Japan (HuMA)

When possible, the affected country's aid and international organizations provide relief support at the site of a large-scale disaster. The UN Office for Coordination of Humanitarian Affairs (UNOCHA) tasks countries to build systems for coordinating and managing many kinds of disaster relief activities.

The Humanitarian Medical Assistance in Japan (HuMA) was organized and established by experienced members of the JMTDR in 1982 in response to reported delays in aid resulting from bureaucratic issues related to inter-agency requests.⁵ As the JMTDR cannot undertake any disaster relief operation without being formally requested to do so by the government of the affected country or an international agency, the HuMA was established to provide needed medical assistance without waiting for a formal request. The HuMA is funded by Japan Platform, which is a system created by NGOs, businesses, and the Japanese government for the purpose of supporting emergency humanitarian relief organizations.

The HuMA has responded domestically and overseas to all types of disasters. In addition to providing medical first aid, they support reconstruction and community re-development. The HuMA provides assistance regardless of race, gender, nationality, religion, or political affiliation, and cooperates with international organizations, such as the World Health Organization (WHO), the UN, other NGOs, UNOCHA, the High Commissioner for Refugees (UNHCR), and national governments. The HuMA also attempts to develop the science of disaster medicine, and provides training and educational programs to its members.⁶

A typical HuMA team consists of two to four doctors, two to four nurses, and one or two logisticians. The management of the daily needs of the team is coordinated by logisticians while the management of medical supplies is the responsibility of the team's nurses.

Nurses' Roles

The responsibilities and duties of the HuMA nurse team members are similar to those of the JMTDR nurse member. However, since the HuMA team consists of less staff than that of the JMTDR, the nurses' activities include more comprehensive duties. At times, they may work as a logistician (e.g., making travel arrangements), coordinate operations, or manage/dispense drugs. In Japan, nurses can undertake pharmacy services under the management and indication of a doctor, according to the Medical Practitioners Law. If there is no pharmacist, pharmacological inventory control and dispensing are performed by nurses.

Education

Since HuMA is comprised only of experienced members of the JMTDR, they all have participated in JMTDR's training course. Additionally, they undertake 34 additional hours of training that may include any of the following: HuMA background and description, description and explanation of activities, disaster phases, risk management, responsibilities of nurses, potential infections, tropical diseases,

	JSDF	JMTDR	HuMA
Education/ Training	On-the-job training	3-day introductory course, plus elective courses	Additional 34 hours of training
Duties	Nursing duties Unit troop duties	Nursing duties Team member duties	Nursing duties Team member duties
Organized strength of a team	1. Medical relief team in a hospital: 1 doctor, 2 nurses, 2 others 2. Logistical support regiment of medical troops: 1 doctor, 14 medical troops including nurses)	21 member team with 1 command chief (Foreign Ministry official), 1 associate command chief (physician), 3 doctors, 1 chief nurse, 6 nurses, 4 paramedics, 4 operational coordinators, 1 pharmacist	2–4 doctors 2–4 nurses 1–2 paramedics
Legal base	The Self-Defense Force Act, The Disaster Countermeasures Basic Act, The Act Concerning Dispatch of Japan Disaster Relief Team	The Act Concerning Dispatch of Japan Disaster Relief Team	Agreement with Japan Platform
Term of dispatch	Several weeks to several months	2 weeks	Several weeks to several months

Table 21.1: Comparison of three Japanese relief organizations (JSDF = Japan Self-Defense Force; JMTDR = Japan Medical Team of Disaster Response; HuMA = Humanitarian Medical Assistance in Japan)

mental health care, stress management, administration issues, logistics, bandaging, application of plaster casts, and disaster-related disease epidemiology. Other educational topics may include public health issues, disaster surgery, the Sphere Project, infant and child care issues, research strategies, cooperation with local staff, medical collaboration and cross-cultural understanding, wound assessment, general exercises and drills, assessment of injuries, setting up of a first-aid station, care of injuries, medical resources, and methods of disinfection.

CONCLUSION

Japanese disaster relief services may be provided by three national organizations (Table 21.1). Each organization has its characteristic requirements for response. These differences result from their organizational scheme; both the JDF and the JMTDR are governmental organizations while the HuMA is a non-governmental organization. However, the responsibilities of the nurse members of these teams are fairly consistent throughout the organizations. The primary difference among the groups is the impetus for dispatch. As

DISASTER RESPONSE TO THE 1995 GREAT HANSHIN-AWAJI EARTHQUAKE

On 17 January 1995, more than 6,400 lives were lost as a result of the Great Hanshin-Awaji earthquake in Japan. Of the 180 hospitals in the affected area, 179 suffered some type of damage or impaired lifelines; 40% of the physicians and 60% of the nurses did not report to work after the event.

Due to a variety of factors, the Japan Self-Defense Forces (JSDF) were not mobilized until almost 24 hours after the event and, then, were hampered by a lack of experience, lack of appropriate equipment, and inaccessible roads.⁷ (The JSDF now can "autonomously dispatch" themselves in the event of an earthquake >6.0 in magnitude.)

Volunteer residents performed most of the extrication of entrapped victims during the first few days after the event, and thousands of volunteers were involved in the immediate recovery period. In Japanese history, 1995 became known as the "year of volunteerism", because of the outpouring of volunteers to assist the affected people; an estimated 1.37 million volunteers responded in some way during the first year following the event.^{8,9}

members of organizations such as the JDF, relief dispatch is one of the nurses' assigned duties for which they are trained and prepared. However, in the JMTDR and the HuMA, the disaster response team consists of voluntary members, making it difficult to ensure sufficient available, trained human resources.

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CHAPTER 22

PREPAREDNESS OF THE ISRAELI HEALTH SYSTEM FOR EMERGENCIES

Bruria Adini, Robert Cohen, Daniel Laor

THE STATE OF ISRAEL WAS ESTABLISHED in 1948 and currently has a population of approximately 7 million inhabitants. Since it was founded, the state has fought six wars and has been subjected to thousands of terrorist-initiated incidents and to missiles and rockets that were targeted at the civilian population. In addition to these threats, the state has had to deal with the possibility of non-conventional missile attacks that have emanated from the second Gulf War. Thus, the state of Israel has had to develop an infrastructure and a readiness to deal with conventional and non-conventional terrorist attacks.

OBJECTIVES:

- Understand the organizational structure of Israel's Ministry of Health (MOH);
- Understand and describe the training and preparedness programs;
- Describe the four major threats identified by Israeli MOH; and
- Understand Israel's principles for dealing with mass-casualty incidents.

In order to prepare the healthcare system to deal with these threats, emphasis has been placed on the development of an integrated network of agencies that operate under the coordination of the Ministry of Health (MOH). This network, the foundation of which was established 25 years ago, has the primary responsibility for preparing the medical services required to deal with all types of mass-casualty incidents (MCIs). The network includes Emergency Medical Services (EMS), Health Maintenance Organizations (HMOs), which are responsible for the delivery of ambulatory primary health care in the community, all general hospitals, rural, peripheral, and Level-1 trauma centers, the Israel Defense Forces (IDF) Medical Corps, and the Home Front Command.

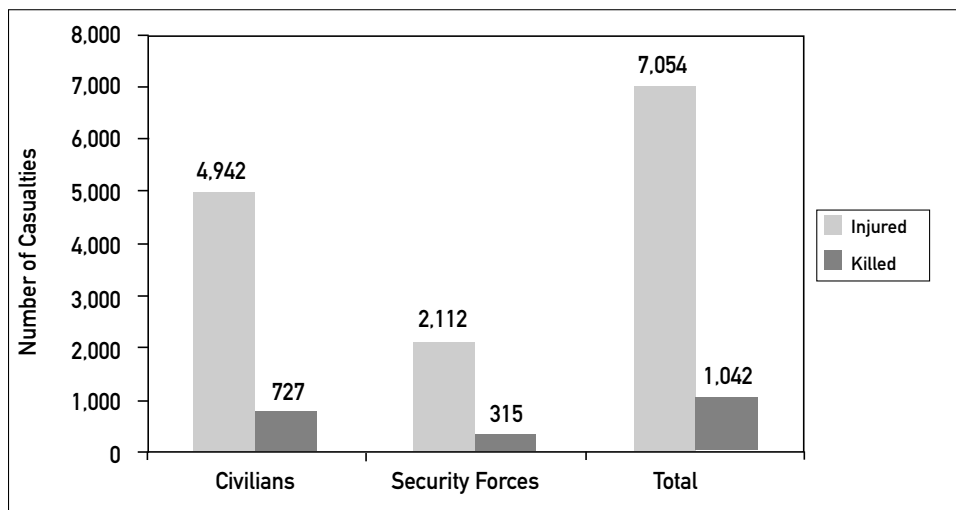


Figure 22.1: Casualties from 29 September 2000 to 1 January 2005

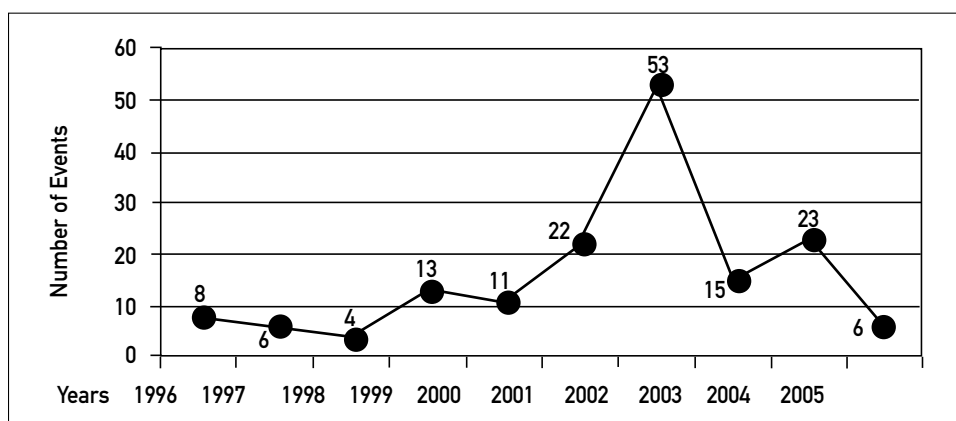


Figure 22.2: Mass-casualty Incidents (>10 casualties) from 1996 through 2005

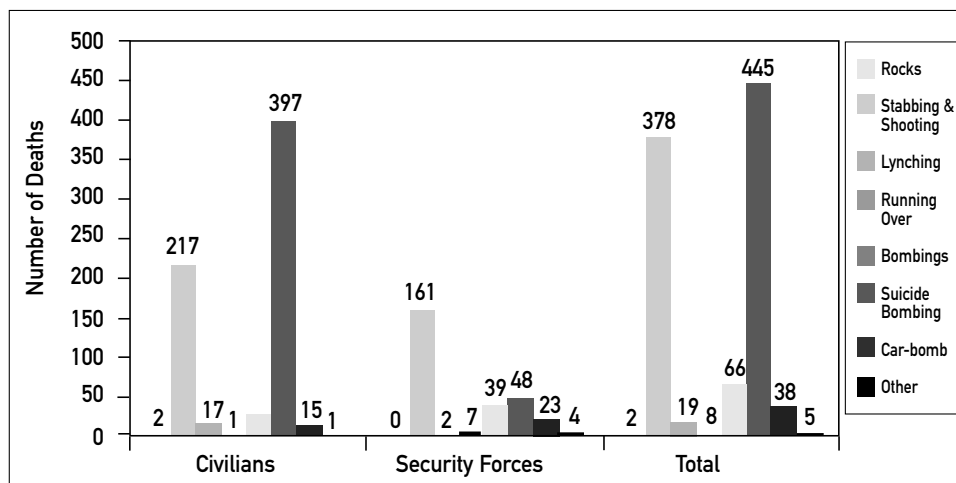


Figure 22.3: Mortality of civilians and security forces as a result of terrorist attacks

THE BURDEN OF TERRORISM IN ISRAEL

Since the outbreak of the second “Intifada” in September 2000 until May 2006, more than 20,000 terrorist attacks have occurred in Israel, resulting in more than 7,800 casualties (Figure 22.1).¹ The majority of these casualties have been civilians. The incidence of MCIs (with >10 casualties per incident) as a result of terrorism from 1996 to 2005 is diagrammed in Figure 22.2.

Figure 22.3 provides information on the numbers of civilians and security personnel killed as a result of seven different types of terrorist attacks. As noted in this figure, the majority (445) of the casualties were caused by “suicide bombers”, followed by fatalities from shooting and stabbing incidents (378).

THE EMERGENCY MANAGEMENT OF TERRORIST EVENTS

The contingency plans for responding to all potential scenarios focus on four major threats: (1) MCIs from conventional terrorist attacks; (2) toxicological attacks, including the involvement of gas agents; (3) radiologically-related incidents; and (4) bioterrorism. Plans for dealing with each of these types of events have been developed and training exercises are performed on a regular basis in all the institutions in the country that are likely to respond to these incidents.

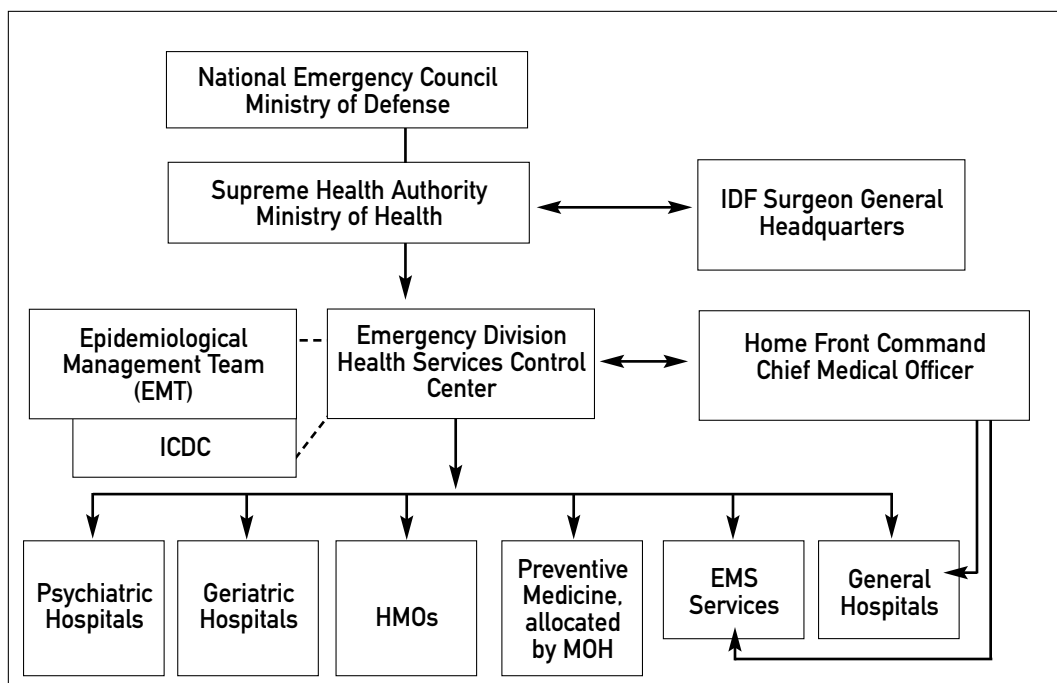


Figure 22.4: Overall structure of Israel's Disaster Health System (IDF = Israeli Defense Force; ICDC = Israel Center for Disease Control; HMO = Health Maintenance Organization; MOH = Minister of Health; EMS = Emergency Medical Services)

The basic model utilized for managing these different types of events is the model developed for dealing with MCIs from conventional attacks with modifications integrated into each of the contingency plans for dealing with each specific type of attack.

NATIONAL DISASTER HEALTHCARE SYSTEM STRUCTURE

The National Emergency Council (NEC) of the Ministry of Defense is responsible for Israel's overall preparedness for emergencies. Under the jurisdiction of the NEC, each ministry operates a specific council responsible for the emergency preparedness in the elements of the ministry. The Ministry of Health operates a Supreme Health Authority (SHA), which was established in 1975, in order to coordinate the medical aspects of managing emergencies in the country; the Director-General of the Ministry of Health serves as the Chairman of the SHA. Other members of the SHA include the directors of the four Health Maintenance Organizations that are responsible for providing both ambulatory and hospitalization services, and the Surgeon General of the Israeli Defense Forces. The SHA formulates policy and maintains a system for assessing the readiness of both healthcare personnel and institutions that are required to provide services in the event of an MCI.

The Division of Emergency and Disaster Management established by the Ministry of Health operates under the jurisdiction of the Supreme Health Authority. This division has the day-to-day responsibility for assuring the level of preparedness of all the medical organizations involved in dealing with MCIs, including the general hospitals, the Emergency Medical Services (ambulance services), psychiatric and geriatric medical centers, primary care clinics, and the health districts responsible for preventive medical services.

The Israeli Defense Force Medical Corps and the Medical Department of the Home Front Command operate in coordination with the civilian medical system, and are authorized by the Ministry of Health to take responsibility in the field for regulating casualties and alerting general hospitals in the event of a MCI. The Home Front Command also is responsible for the training of medical personnel and implementing training exercises for the civilian hospitals.

The Supreme Health Authority operates an Epidemiological Management Team (EMT), which is an advisory committee for biological events. This committee is comprised of senior personnel from various medical organizations who function as volunteers in peacetimes and during exceptional biological events.

In order to coordinate all operations and follow-up on implementation of the SHA's instructions, a Central Operation Center is activated by the Emergency and Disaster Management Division during all emergencies.

ESTABLISHMENT OF NATIONAL DOCTRINES

In order to prepare institutions and their personnel to manage MCIs as efficiently and effectively as possible, the Ministry of Health has developed a national doctrine for each potential threat. These doctrines are established by special committees consisting of experienced senior medical personnel from the various medical agencies and contain the standard operating procedures required to deal with an MCI from conventional terrorist attacks, toxicological or chemical events, as well as bioterrorism and radiological events. The doctrines are provided to all of the relevant medical organizations, which then develop standard operating procedures specific to their institution and infrastructure.

TRAINING OF MEDICAL PERSONNEL

Extensive training programs for both medical and paramedical personnel focus on the four major terrorist threats (conventional terrorist attacks, toxicological attacks, radiological attacks, and bioterrorism), but also can be tailored to other specific threats as a result of rising tensions in the immediate geographical area. A most notable example of this was the massive educational program for medical personnel implemented during the lead-up to the second Gulf War in 2003, when the threat of a biological missile attack was high. During this period, more than 3,000 medical personnel participated in a series of one-day workshops preparing them to deal with casualties of biological warfare.

The training programs are based on the following principles:

- All training programs, including drills, are compulsory for all institutions. The Ministry of Health is responsible for the supervision and maintenance of these programs, and also determines the frequency with which institutions are required to participate in the exercises. On average, each institution participates in a drill at least once every year;
- The training programs follow a standard format, but can be modified to meet the specific needs of the participating organizations. The training programs use active learning techniques along with simulation of realistic scenarios, based on the availability of resources. The instruction is directed to the specific needs of the trainees (whether prehospital or hospital personnel). An essential component of the programs is the immediate provision of constructive feedback to facilitate improvement of the program;
- Training programs are evaluated and continually revised. At the present time, a major effort is being directed toward the development of evaluation tools that will provide reliable and valid assessment of the effectiveness of the training programs; and

- Teams of health professionals from within each organization are trained and provided with necessary materials and resources to allow them to function as trainers and conduct the training programs in their institutions. These teams include physicians, directors of nursing from departments involved in the management of an MCI, and other relevant personnel. Special training programs also are provided to the members of the hospital Emergency Committees, who are responsible for preparing their institutions for MCIs.

The Ministry of Health utilizes diverse instruction tools in the training programs. These include:

- *Interactive computer programs* for individual instruction of physicians and nurses in treating multiple casualties of conventional terrorist attacks;
- *Educational films* that demonstrate the overall contingency plan for the management of casualties from conventional, toxicological, and chemical warfare terrorist incidents, and the operation of information centers;
- *Sectorial training kits*, which include all of the necessary training materials for individual staff members, the unit, and for the healthcare organization as a whole;
- *Medical Simulation Center* for the clinical training of physicians and nurses from departments that, as a rule, are not involved in the management of mass casualties, but who may be called upon to function in the emergency departments during an MCI;
- *Simulation (table-top) exercises*, which enable the senior staff members in the various organizations to deal with many of the complex issues that arise during MCIs;
- *Annual drills*, a crucial component of the training programs, to provide valuable lessons that are immediately included in the standard operating procedures of the participating institutions; and
- *After-Action Reviews (AARs)* to provide an opportunity for organizations to learn and improve their skills in preparation for the next time they are required to manage an event for which they have responsibility.² Experience has demonstrated that the implementation of AARs immediately following an MCI significantly contributes to the effective management of events and the provision of high-quality care for casualties.

ASSESSMENT OF READINESS

Assuring that hospitals and EMS services are prepared to deal with MCIs requires ongoing assessments of their level of readiness. To this end, the MOH has developed a readiness evaluation tool for both the supervisory offices and the medical institution's administration. The assessment is performed every two years in each hospital and EMS district, and is based on objective standards provided to each institution prior to the evaluation. The evaluators are professionals from the MOH and the Home Front Command. The level of preparedness is rated according to the predetermined criteria established for evaluating the readiness of the institution for dealing with MCIs. If the institution is found lacking, it is required to prepare an improvement plan with the assistance of the evaluators, who use benchmarking to facilitate and enhance the improvement process. The topics evaluated include SOPs, training and instruction, personnel, logistics, and also include enabling factors and the information obtained from both drills and actual MCIs.

INFRASTRUCTURE AND EQUIPMENT PROCUREMENT

In order to assure the capabilities of the medical system to cope with all types of potential emergencies, the MOH is responsible for the procurement and storage of critical equipment. This equipment includes life-saving electronic devices (such as ventilators, monitors, antidotes); pharmaceuticals for toxicological, chemical, and biological agents; disposables; and personal protective equipment. A large portion of the equipment is distributed to the hospitals proactively and is stored in the immediate vicinity of the hospital's ED. The remaining equipment is stored by the MOH in district warehouses, with a contingency plan to deliver it within hours to hospitals requiring re-supply during an MCI. Vital infrastructure (including decontamination sites for toxicological or chemical warfare casualties, water reservoirs, generators, oxygen tanks, and helipads) have been constructed by the MOH in most general hospitals. In addition, mutual communications systems have been introduced in order to improve the control systems and enable the hospitals to mobilize their personnel in an optimal way.

CONTINGENCY PLAN FOR MCIs

The preparedness of Israel's healthcare system for managing MCIs is based on ongoing coordination between EMS and all general hospitals. At the site of the event, EMS operates under the command of the police force, and is responsible for performing triage, evacuating casualties, and notifying hospitals.

All general hospitals are required by the MOH to be prepared to treat casualties from an MCI, based on the following principles:

- The surge capacity of the hospital must be >20% of routine bed capacity;
- Pre-designated admitting sites can be *deployed immediately*;
- A call-up of medical and nursing personnel is activated;
- Life-saving equipment stored inside of the EDs is allocated to all admitting sites, based on regularly exercised standing orders;
- Triage is conducted at the evacuation site, according to severity of injury — classified into two categories: immediate or ambulatory injury;
- MCI protocols are implemented; and
- Information centers utilize a computerized casualty identification system to inform family members regarding relatives involved in the event. The information obtained is distributed on-line to all general hospitals.

In order to ensure preparedness for all possible scenarios, contingency plans have been formulated based on other scenarios, such as a toxicological/chemical MCI and bioterrorism.

CONTINGENCY PLAN FOR TOXICOLOGICAL/CHEMICAL MCIs

The preparedness for a mass toxicological incident (MTI) in Israel is based on the contingency plan for conventional MCIs, with the necessary modifications for hazardous materials. The main principles are:

- At the site of the event, the treatment of the exposed population is limited to basic, life-saving treatments, with no decontamination, except the undressing of immediate casualties;
- The EMS teams are equipped with personal protective gear stored in each ambulance (two sets/vehicle);
- The hospitals serve as the main evacuation destination, and as the only site for decontamination;
- The surge capacity of the hospitals is expanded, based on the preparedness for a conventional MCI, to at least 20% of bed capacity in order to receive a large number of self-evacuated casualties suffering from light exposure to hazardous materials, stress symptoms, or the “worried well”;
- The hazardous materials are classified into 12 groups according to similar traits; the appropriate contingency plan is activated based on these classifications;
- The treatment of casualties is based on Advanced Trauma Life Support (ATLS) and Basic Life Support (BLS) guidelines, integrated with procedures for treatment of casualties of a

- specific toxic material;
- Medical personnel are protected from secondary contamination by personal protective gear stored in the immediate vicinity of the ED; and
- The triage of casualties is conducted twice in the hospital; the first is a functional triage performed at the entrance to the decontamination site, separating the lying casualties from the ambulatory casualties; the second triage is conducted following decontamination, based on the casualty's respiratory status, walking ability, and severity of general injury (toxication only versus combined injury).

CONTINGENCY PLAN FOR BIOTERRORISM

The Israeli healthcare system also has prepared a response plan for bioterrorism, including toxins, viruses, and bacterial agents. A computerized monitoring system, utilizing ongoing reports from all relevant sentinels, including hospitals, HMOs, the epidemiological department of the MOH, and the Israeli Center of Disease Control, provides early detection of any unusual signs of morbidity or mortality.

Risk assessment and incident control methodologies have been developed to assist the National Management Agency in controlling and coordinating all operations. For example, to cope with an anthrax threat, a network of distribution centers has been prepared in HMO clinics to allocate the necessary antibiotics to the population at risk. Also, a contingency plan for coping with the threat of a contagious disease, such as smallpox, has been constructed that includes a plan for the rapid vaccination of the population. First responders from the various organizations who have been previously vaccinated against smallpox, serve in the immediate response teams, and will be activated should a case of smallpox be detected. The necessary stockpiles for a biological event are maintained and operated by the MOH, to be deployed should the need arise.

CONCLUSION

Coping with MCIs has been a major challenge for Israel's healthcare system during the past five years. A significant effort has been made to ensure the preparedness of the healthcare system for all potential scenarios. Time and effort have been devoted to preparing simple and implementable, operative, contingency plans so that the response models of organizations will be effective. To achieve this goal, the medical preparedness for emergencies is based on generic, universal, response models.

The provision and retention of knowledge and skills of the health professionals required to deal with the different types of potential MCIs are pri-

mary objectives of the MOH. Effective preparedness for emergencies requires a process of ongoing AARs of both training events and actual MCIs. This process fosters learning and allows for planning and updating of protocols and standing orders in all medical organizations. Regular monitoring of the level of preparedness of hospitals and the other organizations involved in dealing with MCIs is one of the key requirements for maintaining the optimal readiness for all emergencies.

Although the experience acquired dealing with many MCIs has most likely contributed to improved performance, it also has taken a heavy toll in terms of the motivation of the healthcare personnel. This, and the fact that the state has been required to provide the funds necessary for maintaining the infrastructure to ensure a high level of preparedness, have added to the heavy burden already being born by the population at large. Regular monitoring of the level of preparedness of hospitals and the other organizations involved in dealing with MCIs is one of the key elements for maintaining optimal readiness for all emergencies.

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CHAPTER 23

PUBLIC HEALTH RESPONSE

Jane V. E. Richter

THE GLOBALIZATION OF THE ECONOMY and travel have introduced a host of new challenges for public health partners at the local, state, national, and international levels. Compounding these issues are the emergence of new infectious diseases, increased numbers of immunocompromised individuals, increased antibiotic resistance, and the threat of bioterrorism. The recognition that no one country is able to survive on its own in the face of such adversity has led to unprecedented efforts to connect with global health partners.

OBJECTIVES:

- Describe the importance of surveillance systems in detecting and responding to infectious disease outbreaks;
- Describe the role of epidemiologists in analyzing data and monitoring for disease patterns or unusual occurrences of illness; and
- Understand the interdependency of local, state, national, and international public health agencies in safeguarding the global population.

PUBLIC HEALTH ROLE

Public health agencies at all levels of government have core functions that include assessment, policy development, and the assurance that the conditions in which we live are conducive to health.¹ These functions are carried out daily in local and state health departments, Ministries of Health, the Centers for Disease Control and Prevention (CDC), and the World Health Organization (WHO).

Assessments

Assessments involve the gathering and synthesizing of data and information that allow for the identification of strengths and weaknesses within the public healthcare system. In the current era of terrorism, public health assessments

have evolved to include the cataloging of existing healthcare capabilities, such as the numbers and types of hospital beds (e.g., burn or pediatric beds) available on a daily basis, and comparing these to resources estimated to be needed in a mass-casualty event. Examples of healthcare resources that must be cataloged include: the number and location of available ventilators; available medications to treat biological or chemical threats; personal protective equipment (e.g., respirators, gowns, gloves, and faceshields); and the number and locations of off-site facilities that are available for the provision of medical care in an emergency. When the estimated resources needed exceed those that are readily available, the identified gaps must be addressed either through the procurement of additional resources, or the development of strategies to prioritize how the limited assets might best be used.

Surveillance is an assessment function essential to safeguarding the public. Surveillance entails the systematic observation, collection, and analysis of data that allows for the early detection, and identification of and response to a disease in order to limit its impact.

Syndromic surveillance involves collecting and analyzing statistical data on health trends (such as the percentage of children absent from school, or the number of prescriptions being filled for diarrhea) rather than dealing with any confirmed, specific diagnoses. The goals of syndromic surveillance are early detection and intervention to limit the progression of a disease outbreak.²

Surveillance that is community-wide requires cooperation from a variety of stakeholders: pharmacies, physician practices, emergency rooms, schools, day-care centers, emergency medical services, veterinarians, and others. Public health relies on these “eyes and ears” within the community to detect and report immediately to the health department the occurrence of any unusual symptoms or clusters of symptoms.

Policy Development

The public health community often works to influence the governmental process to develop legislation that addresses potential and actual dangers to the public's health. One major US policy development initiative that was the direct result of the terrorism attacks in 2001, is the Model State Emergency Health Powers Act developed by the Center for Law and the Public's Health at Georgetown and Johns Hopkins Universities.³ This legislative prototype has been adapted and adopted by many state legislatures in order that governors and state public health authorities are able to act swiftly and comprehensively in the event of an emergency that has the potential to impact severely the public's health and safety. The powers granted by this Act include the ability and responsibility to isolate and/or quarantine individuals from the population at large in order to interrupt disease transmission.

During the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, affected governments used their public health authority to limit the spread of the disease. For example, in Canada, public health authorities established a concept of “work quarantine”, whereby those healthcare workers who may have been exposed to SARS at work were permitted to continue working as long as they followed certain mandates: they were required (1) to wear an N-95 mask at all times while at work and during their commute to work, unless they traveled alone; (2) to otherwise not leave their homes or receive visitors in their homes; (3) to wear an N-95 mask in the presence of other members of their household; (4) to sleep in rooms separate from other family members; and (5) to monitor their and family members’ temperatures and report immediately to public health authorities if any signs or symptoms of SARS developed in themselves or their family members.⁴ In Singapore, toolkits containing thermometers and facemasks were issued to every residence and the residents’ temperatures were checked regularly when they were out in public.⁵

Assurance

The third public health core function is that of assurance. Many people mistakenly believe that this function suggests that public health is responsible for providing the services necessary for people to be healthy. However, public health never has accepted sole responsibility for such a daunting task, and the funding available from the various levels of government precludes this from occurring. Rather, it is the mission of public health at the international, national, state, and local levels, to assure the conditions in which people can be healthy. The focus for public health is on the health of the population, not of individuals. If the availability of, or access to, health services is limited or lacking altogether, public health must encourage action by other entities in either the public or private sector, obtain a needed service through regulation, or provide the services directly.⁶

US PUBLIC HEALTH DISASTER ROLE

Public health has experienced many growing pains in finding and assuming its role in emergency preparedness and response efforts at all levels of government. Since the US Homeland Security Presidential Directive #5 was signed in 2003, the national infrastructure has become more robust and the roles more defined with the establishment of a National Response Plan by the Department of Homeland Security.⁷ This plan lays the framework for a comprehensive, “all-hazards” approach to enhance the ability of the federal government to coordinate with state, local, or tribal governments and the private sector. Federal assistance can be provided when requested by a Federal department or agency; when state/local capabilities are overwhelmed and Federal assistance is requested;

when an incident substantially involves more than one Federal department/agency; or, when the Secretary of the US Department of Homeland Security (DHS) has been directed by the President to assume incident management responsibilities.⁸ Under the Notice of Change published after Hurricane Katrina, the Secretary of the DHS can request assets in preparation for an event.⁹

The US National Response Plan incorporates 15 Emergency Support Functions (ESFs), which group response capabilities and resources. ESF #8 covers Public Health and Medical Services and includes the following functional support: assessments of public health/medical needs (including behavioral health); public health surveillance; medical care personnel; and medical equipment and supplies.

The US Department of Health and Human Services (HHS) was assigned as the lead agency for ESF #8¹⁰ in keeping with its “mission as the US government’s principal agency for protecting the health of all Americans and providing essential human services, especially for those least able to help themselves.”¹¹ The department works with assigned federal partners to ensure that public health and medical needs are addressed at the federal level. At state and local levels, responsibilities for these functions vary; in some locales, the state’s appointed Health Officer oversees all public health and medical services, while in others, the responsibilities are shifted to the local level.

NATIONAL AND GLOBAL PUBLIC HEALTH AGENCIES

The US CDC, a component of the Department of HHS, functions as the lead public health agency in the United States, providing training, funding, consultation, capacity building, and technical assistance to all states and territories in support of enhancing emergency preparedness, response, and recovery. Another function of the CDC is conducting and supporting infectious disease research and surveillance. In addition, the CDC works to improve the health of the people of the United States and other nations by partnering with national and international organizations and other governments to build strong, transparent, and sustainable public health systems.

Within some countries, such as Kenya and Thailand, the Ministry of Health (MOH) assumes the responsibility for monitoring the public health on a national level and responding to outbreaks of epidemics and emerging diseases. The Office of Health Protection within the Australian government’s Department of Health and Ageing has policy and planning responsibilities, while outbreak control and surveillance, as well as state policy, are the responsibilities of the individual states.

The European Center for Disease Prevention and Control (ECDC), which has been in existence in Stockholm, Sweden, since 2005, works with

national health protection bodies across Europe to strengthen continent-wide disease detection and early warning systems. The ECDC depends heavily on the infrastructure and expertise of its member states.¹²

Since 1948, a key partner in global public health efforts is the WHO, the directing and coordinating authority on international health within the UN system. More than 8,000 health and other experts and support staff work on behalf of the WHO across the globe.¹³ Two of the WHO's roles are to monitor and assess worldwide health trends, and to provide leadership on matters critical to public health.¹⁴ Like the CDC, the ECDC works closely with the WHO European Regional Office (EURO) to maximize resources and avoid duplication.

PUBLIC HEALTH RESPONSE

Surveillance and Infection Control

Often, when individuals present to emergency departments or doctors' offices with signs and symptoms that are suspicious for a disease known to be very contagious, and/or is associated with high morbidity and/or mortality, the skills of an infectious disease practitioner are engaged. Ideally, the local public health agency is notified in order that a population-based focus can be undertaken to safeguard the public's health. Communication may occur with the state health department, the MOH, the CDC, or the WHO, if deemed necessary by public health authorities.

Since 1951, international regulations governing the public's health have been in existence under the auspices of the WHO. The regulations have been modified several times since, with the latest revision occurring in 2005 (effective date 15 June 2007). In the past, cases of cholera, plague, and yellow fever have been the diseases that required reporting to the WHO. Under the new International Health Regulations (IHR) (2005), any cases of smallpox, poliomyelitis due to wild-type poliovirus, human influenza caused by a new subtype, and SARS are the diseases that are automatically notifiable. Other conditions or events must be assessed using an instrument embedded in the IHR (2005) that assists public health authorities to determine the seriousness of the potential public health impact, the unusual or unexpected nature of the event, the risk of international spread, and the risk that travel or trade restrictions may result. One hundred and ninety-four countries have agreed to be bound by the new regulations; these countries are referred to as "State Parties". Although there is no enforcement mechanism to the IHR (2005), states failing to comply risk serious consequences, such as increased illness and death, trade and travel restrictions, and a loss of international good will. Prompt reporting to the WHO allows for the rapid gathering and assessing of information gained

through its extensive communication network. As appropriate, the WHO recommends actions and provides technical expertise and resources.¹⁵

In 1990, the CDC collaborated with the US Council of State and Territorial Epidemiologists (CSTE) to create a report that, for the first time, provided uniform “case definitions” — that is, criteria for the reporting of infectious diseases. This standardization marked the beginning of data files that are available to clinicians and researchers to identify trends, and to target research, prevention, and control efforts. In 1997, this report was revised and published as *Case Definitions for Infectious Diseases under Public Health Surveillance*. The CDC has not published another report since 1997; however, surveillance case definitions for infectious diseases are available on the CDC¹⁶ and CSTE¹⁷ Websites. In October 2007, the CDC and CSTE concurred that an official and unified list of *nationally* notifiable conditions is needed along with standardized reporting definitions; work currently is underway to provide such a list.¹⁸ This is of particular importance in light of the fact that the reporting of some diseases is mandated by state regulation or law, although the list of notifiable diseases varies slightly from state to state, with no uniformity across the nation.

Data on selected, notifiable, infectious diseases in the United States are published weekly in the *Morbidity and Mortality Weekly Report*, which may be downloaded from the CDC Website (www.cdc.gov).¹⁹ The WHO publishes the *Weekly Epidemiological Record* to disseminate information on cases and outbreaks of diseases of global public health importance.²⁰

Public health surveillance entails the systematic observation of health data so that changes or threats affecting the public’s health can be prevented or detected, monitored, and controlled. Public health departments routinely receive reports of illnesses or unusual conditions from healthcare providers and the public. These reports constitute passive surveillance and often result in gaps in the data. Active surveillance refers to surveillance prompted and actively searched for by public health workers. Active surveillance requires a greater expenditure of resources, but yields more robust data than does passive surveillance. Given the importance of rapid detection and identification of events of public health importance, the new IHR (2005) mandates that each state party/country develop and maintain core public health capacities for surveillance and response. Prompt reporting of such occurrences to the WHO allows for the mobilization of international resources to respond effectively and efficiently.¹⁵

Currently, the states and US territories contribute to surveillance capacity by voluntarily reporting notifiable infectious disease data to the CDC for inclusion in the (NNDSS. These reports are summarized annually and reported each fall in an issue of the *Morbidity and Mortality Weekly Report* (MMWR). However, because reporting at the state level varies and is voluntary, data can-

not always be considered to be complete or used for comparisons between states.¹⁹ Information collected via the NNDSS has allowed for the creation of a baseline, or endemic disease incidence database, which enhances monitoring capabilities. Another system that is available from the CDC is the Early Aberration Reporting System (EARS). This system is being used across the globe to analyze syndromic data or data that represent health trends, such as symptoms being reported or medications being purchased from emergency departments, emergency access calls, physicians' offices, school and business absenteeism reports, and over-the-counter drug sales.²¹

In Europe, an early warning and response system for influenza, the European Influenza Surveillance Scheme (EISS), has been in existence since 1996. The EISS aims to reduce morbidity and mortality from influenza in all of the European Union countries by allowing member countries to enter data into the EISS database, view influenza activity in other networks, and perform detailed clinical and virological queries.²² A weekly bulletin is published on the EISS Website during the influenza season to provide an overview of each country's influenza activity (www.eiss.org).

For many years, surveillance has involved monitoring naturally-occurring infectious diseases. However, since 2001, public health efforts have been reoriented to include the monitoring of intentional acts involving pathogens. The real-time collection of data is highly desirable so that conditions that are detected can be addressed immediately. Data that are collected or analyzed after the fact may enrich a database, but fail to allow prompt intervention(s) that assures the health and safety of the public. Recognizing this, public health authorities have embraced the need for surveillance systems that provide simultaneous access to health data by all levels of public health. Such capabilities decrease delays in both the recognition of a problem and the start of mitigation efforts.

The occurrence of outbreaks, or potential outbreaks, detected through either active or passive surveillance, sets off a cascade of public health activities, especially when the report or finding seems to indicate involvement of a pathogen capable of causing high rates of morbidity or mortality. Such a finding is termed a "*sentinel event*" because it signals the need for a rapid and effective response by public health in order to decrease the incidence of illness and deaths. Therefore, it is imperative that public health departments have a widely-publicized and accessible telephone number for use in the reporting of any immediately notifiable illness, unusual disease, or outbreak. Additionally, the public health department must have the ability to receive reports 24 hours a day, seven days a week, and to handle each according to an established triage protocol to ensure an effective and efficient response. Public health departments continually must solicit the support of physicians and other healthcare practitioners to assure that surveillance activities and

appropriate reporting occur, as needed, to safeguard population health.

When a health condition is identified that has the potential to affect the community, public health is responsible for assuring certain activities designed to ameliorate the threat. Strategies can be undertaken to inform those at risk using a variety of media, such as newspapers, television, radio, or the Internet. Perhaps the mitigation strategy will involve calling attention to a specific product lot suspected in an outbreak or that has been recalled. Or, as occurred in the case of the anthrax attacks of 2001, outreach efforts may be targeted to those working in particular facilities or with some other common exposure to the biological agent.

Epidemiological Investigation

When a local health department receives a report of an immediately notifiable illness, unusual disease, or outbreak, the skills of the epidemiologist and the epidemiology team are pressed into service. *Epidemiology* is the study of the distribution and causes of disease in populations. Epidemiologists determine how many people or animals have a disease, the outcome of the disease (e.g., recovery, death, or disability), and the factors that influence the distribution and outcome of the disease.²³ Using a systematic and deliberative process, an epidemiological investigation is launched so that a common source for the illnesses can be identified, and steps taken to treat those who are affected while preventing further exposures. Depending on the resources available to conduct an investigation, or the nature of the suspected illness or disease, the local health department may request the services of the State Health Department or MOH, which may, in turn, request the assistance of the CDC or the WHO, as appropriate. The assistance provided can range from a telephone consultation to the deployment of a rapid response team to assist the requesting public health authority.

A basic epidemiological investigation involves the following steps:

1. Determine if an outbreak seems likely by reviewing available data and discussing findings with appropriate local public health officials;
2. Verify the diagnosis of the index case (i.e., the first case) by examining medical records and laboratory reports and discussing the diagnostic criteria with the reporting health professional(s);
3. Develop a case definition by determining a standard set of criteria for classifying a case as definite, probable, or suspect, based on clinical, laboratory, and epidemiological data;
4. Begin contacting others suspected of being similarly exposed to determine if they are similarly ill, and to identify if there are any person-, place- or time-linkages to the index case, or to the initial exposure;

5. Formulate a working hypothesis of where, when, and how the exposure and subsequent outbreak occurred;
6. Develop an epidemiologic curve, (i.e., a graph that depicts the number of cases and the onset of each), and determine the prevalence, incidence, disease attack rate, and mortality rate;
7. Design a survey that will guide the interview process and standardize the information collected;
8. Determine the existence of additional cases through active and passive surveillance strategies to determine the extent of the outbreak;
9. Develop a listing of those individuals affected in order to identify commonalities, as well as any other considerations that will assist in the investigation;
10. Collect and test appropriate clinical and environmental samples;
11. Put control measures into effect and evaluate their effectiveness;
12. Use the appropriate media outlets to communicate and inform the public of the outbreak and the investigation findings; and
13. Document what occurs as the investigation proceeds to include conclusions and recommendations. The “lessons learned” are invaluable to enhancing the effectiveness and efficiency of future epidemiological investigations.

Tools such as Epi Info™ (www.cdc.gov/epiinfo) have been developed to facilitate scientific inquiry.²⁴ This public domain software is available from the CDC and is designed for the global community of public health practitioners and researchers. It provides for easy form and database construction, data entry, and analysis with epidemiological statistics, maps, and graphs.

Control Measures

When public health officials determine that control measures are needed to protect the public, there are several possible actions to be taken; each one must be weighed in terms of its benefit versus its cost, especially in terms of social consequences. Some basic control measures are the most effective and easiest in terms of public behavior, e.g., hand-washing practices, coughing and sneezing hygiene, distancing from those who are ill, and staying home when sick. Two of the most powerful and controversial actions that public health can take are those of isolating or quarantining an individual or group of individuals. Isolation occurs when a person is ill and his/her movements are restricted to keep others from being exposed and becoming ill. Isolation occurs frequently in our society, e.g., when an ill child is excluded from school and kept away from other children, or when a patient infected with a contagious disease, such as bacterial meningitis or active tuberculosis is isolated. Quarantine involves restricting the

movements of someone who has been exposed, or potentially exposed, to a person with a contagious disease, but currently shows no signs of the illness. Both quarantine and isolation require that the basic needs of the individual are met while their movement is restricted. Public health authorities take both of these

THE ROLE OF THE COMMUNITY HEALTH NURSE DURING A DISASTER

There are many roles within multiple venues that the Community Health Nurse (CHN) can assume during a disaster. CHNs have capabilities to serve as disaster managers, direct care providers, education and support managers, risk communicators for population groups, and as consultants to other responders who are coming to the community for the first time. CHNs are a recognized workforce asset for planning and response efforts at the community level.²⁵

In the case of biological events, CHNs frequently have skills in case investigation, community level surveillance, and research, all of which are critical to monitoring the transmissibility of an infectious disease. Common needs for a shelter-in-place community population (such as delivery of medication, vaccinations, prophylactic antibiotics, and anti-viral medications) are common practices of CHNs who work daily in public health clinics or “door-to-door” in local community neighborhoods.

Each role performed by the CHN in these venues requires a specific job or activity performed during a coordinated response to any emergency or disaster. This role may be the same as, similar to, or different from that which usually is performed by the responder during an ordinary work day. In order to be prepared to rapidly assume specific emergency response functional roles, the CHN first must be competent in basic emergency preparedness for public health. Readiness competencies that have been identified for all public health workers, including clinical staff, are the ability to:²⁶

- Describe the role of public health in a range of emergencies;
- Describe the chain of command for emergency response;
- Identify and locate the agency emergency response plan;
- Describe and demonstrate likely emergency response functional roles;
- Demonstrate correct use of communications equipment;
- Describe specific communication roles for oneself at the agency, media, public and personal/family levels;
- Identify limits to one’s own knowledge, skills and authority, and key resources for referral;
- Recognize signs of unusual events and know appropriate actions for reporting; and
- Apply creative problem solving and creative thinking, and evaluate all actions taken.

Kristine Qureshi

actions very seriously and will select other control measures whenever feasible, but always with the good of the public as the primary concern.

Sometimes, public health officials determine that in order to control an outbreak, individuals exposed to the infected persons or agent (e.g., anthrax) need to receive antibiotics or a vaccine to prevent an illness from occurring. If the number of persons identified to be at risk is large compared to the resources available to assist with the efforts, they may be asked to come to a Point of Distribution site to receive the necessary prophylaxis. Points of Distribution may be set up in schools or auditoriums in order that large numbers of the public can be triaged and treated efficiently and rapidly.

CONCLUSION

A myriad of duties and activities are required to protect the public's health. Resources that support public health — whether human, logistical, or financial — must be leveraged from both the public and private sectors as the need outstrips the availability. Numerous challenges will persist, especially in light of the fact that public health rarely is funded adequately, perhaps because it often is misunderstood and, therefore, undervalued. A robust and sustained commitment from all public health partners across the globe is crucial to our survival. Leading the way in such efforts are the WHO, the CDC, and the countries that have agreed to uphold the IHR (2005), the most powerful tool in today's public health armamentarium.

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CHAPTER 24

PANDEMIC PLANNING

Lynn A. Slepски

“WE DON’T KNOW WHEN a pandemic might strike. But we can be sure of two things: Everything we do before a pandemic will seem alarmist. Everything we do after a pandemic will seem inadequate. This is the dilemma we face, but it should not stop us from doing what we can to prepare. We need to reach out to everyone with words that inform, but not inflame. We need to encourage everyone to prepare, but not panic.”

Secretary Michael Leavitt, US Department of Health and Human Services
Pandemic Influenza Leadership Forum, 13 June 2007

JUNE 2009 MARKED THE BEGINNING of a global influenza pandemic. For the first time, and in response to confirmed infections from a novel influenza virus in 74 countries, the World Health Organization (WHO) raised the pandemic alert from “5” (denoting widespread human transmission) to “6” (pandemic phase). In her announcement, the WHO Director General revealed that large numbers of cases of the viral illness had been reported in nations having good surveillance and testing procedures, with unknown numbers of cases occurring in developing countries. She warned:

Countries should prepare to see cases, or the further spread of cases, in the near future. Countries where outbreaks appear to have peaked should prepare for a second wave of infection.¹

OBJECTIVES:

- Define common terms related to an influenza pandemic;
- Understand factors contributing to pandemic disease transmission;
- Identify appropriate pharmacological and non-pharmacological interventions to be implemented by healthcare providers;
- Identify challenges to health systems leadership and coordination during a pandemic; and
- Understand the resource tools available to healthcare practitioners, including access to current recommendations for the prevention and treatment of pandemic influenza.

No one can predict the length or severity of the next pandemic.² The possibility of a worldwide influenza pandemic has prompted countries and their healthcare industries to develop catastrophic plans addressing this very real threat — a threat that now has been realized. As a result, all healthcare personnel must be prepared to respond to this event, both personally and professionally.

An influenza pandemic occurs when an animal influenza virus to which most humans have no immunity, undergoes changes, becomes capable of causing sustained human-to-human transmission, and results in community-wide and, potentially, worldwide influenza outbreaks.

An influenza pandemic is very different from, and far more serious than the usual seasonal influenza outbreaks that occur each year. A pandemic is an outbreak that may affect hundreds of millions of people, leading to a large proportion of them becoming ill. An influenza pandemic will not stop at borders or respect economic, political, or geographical boundaries.

DEFINITIONS

To understand the issues relevant to pandemics, it is important to understand the terms that are used commonly in discussing influenza pandemics.^{2,3}

Influenza viruses are classified into three types — A, B, and C — based on the arrangement of their surface envelope glycoproteins, hemagglutinin (H), and neuraminidase (N). Hemagglutinin is responsible for the attachment and entry of the virus into the host cell, while neuraminidase is essential to the release and propagation of the virus.⁴ There are 16 types of hemagglutinin and nine types of neuraminidase; all have been found in domestic and wild birds. Only three types of hemagglutinin (H1, H2, H3) and two types of neuraminidase (N1 and N2) have been known to cause disease in humans.⁴

The influenza A viruses are found in many animals, including birds, pigs, horses, seals, and whales; wild birds are natural hosts. Influenza A viruses also can infect humans, are responsible for most seasonal influenza, are the most virulent, and cause the most severe disease. The naming of the different types of influenza A virus is based on the H and N protein configuration on the virus (e.g., H1N1 and H5N1). Currently, only two types of these influenza A viruses (H1N1 and H3N2) are circulating as seasonal influenza.⁴ The influenza A viruses have been responsible for every influenza pandemic to date.⁵

Influenza B viruses are found almost exclusively in humans, and cause viral illnesses that are less severe than influenza A. The influenza C virus causes only mild illness, and can be found in humans and swine; it is one of the many causes of the common cold.

Seasonal (or common) flu is a contagious respiratory illness caused by influenza viruses that can be transmitted easily from person to person. Contact can

be direct through inhalation of the aerosolized virus transmitted from infected persons during coughing or sneezing, or by physically contacting contaminated objects or persons and then touching the mucous membranes of one's mouth, nose, or eyes. Seasonal flu occurs annually and can cause mild-to-severe illness in people. The incubation period is usually one to four days; adults usually are infectious for five days, beginning one day before the clinical onset of their illness. Children shed more viruses than do adults, and immunosuppressed persons as well as those with severe cases of influenza shed viruses longer, and, therefore, are infectious for longer periods.⁶ Symptoms occur quite suddenly following exposure and generally consist of fever (38–39°C), with or without chills, upper respiratory symptoms (cough, sore throat, rhinitis), and systemic manifestations (myalgia, fatigue, malaise, headache). Most people are symptomatic for more than seven days, restrict their activities for five to six days, and are absent from work an average of three days; >50% of symptomatic persons seek medical treatment.⁶

In England and Wales, >12,000 persons, mostly elderly, die as a result of seasonal flu each year.⁷ In the United States, influenza and influenza with pneumonia are responsible for 36,000–40,000 deaths, >200,000 hospitalizations, and >US \$10 billion in direct medical costs and lost productivity annually.⁸ Most people have some immunity to circulating influenza viruses. Generally, the vaccine consists of a maximum of three subtypes from viruses that are circulating throughout the world, combining two different subtypes of Influenza A and one subtype of Influenza B.

Avian Influenza (the H5N1 virus) is an infection caused by avian or bird influenza viruses that occurs naturally among birds worldwide; it has been found in birds in 62 countries.⁹ Birds carry the viruses in their intestines, but usually do not get sick from it. However, the virus is easily transmitted from wild birds to domesticated birds (such as chickens, ducks, and turkeys), and has caused some infections in humans. Transmission can occur through direct contact with infected birds or through contact with surfaces (such as dirt or cages) or materials (such as water or feed) that have been contaminated with the virus. Domestic birds have no immunity to the virus and, thus, die from the viral infection. Avian influenza may be transmitted to other species and potentially could mutate to cause more virulent and transmissible human-to-human infections.¹⁰ Although humans rarely become ill with H5N1 viruses, since its emergence in 2003 there have been 408 laboratory-confirmed cases in humans, and 254 (62%) disease-related deaths as of 18 February 2009.¹¹ Most of those who died had been in very close contact with the virus, usually through contact with infected poultry; there have been rare cases of person-to-person transmission of this virus. Scientists believe that the H5N1 virus is a likely source of a global flu pandemic in humans, as it may mutate into a form transmitted easily from person to person.³

Swine flu is a novel H1N1 type A of swine origin that was detected initially in humans in Mexico in April 2009. The virus is capable of person-to-person transmission in the same way that other flu viruses spread, i.e., through infectious respiratory droplets released when a person coughs, sneezes or talks. Reported initial symptoms are similar to seasonal flu, such as fever, body aches, headache, rhinorrhea, sore throat, and cough; a number of people have experienced vomiting and diarrhea. Some people infected with the virus became severely ill. A small number of deaths have been related to the H1N1 influenza virus. At this time, it is uncertain how severe this novel H1N1 outbreak will be in terms of illness and death compared with other influenza viruses. Because this is a new virus, most people will not have immunity to it, and illness may be more severe and widespread, particularly during its second wave. Thus, a possible pandemic involving the H1N1 type A influenza virus is of major concern. A vaccine to protect against the H1N1 influenza virus is being developed.

An **epidemic** is a specific disease outbreak that begins with a single source and becomes widespread to involve more persons than expected during a given period of time. Epidemics can occur within a group, population, community, or geographic area.¹²

A **pandemic** is a global disease outbreak that occurs over a very wide region (several countries or continents), and affects large numbers of people. An influenza pandemic is caused by a novel or re-assorted virus for which the population has

SEASONAL INFLUENZA	PANDEMIC INFLUENZA
Follows predictable patterns	Unpredictable Usually occurs worldwide in a pattern of ≥ 2 waves, each lasting 12–18 weeks over a period of 12–18 months
Some immunity from previous exposures	All populations are vulnerable
Usually healthy adults are not at risk for serious complications	At-risk populations not yet known — likely to include infants, the elderly, pregnant women, and persons with chronic or immunosuppressive medical conditions
US annual average morbidity and mortality: ➤ 226,000 flu-related hospitalizations; ➤ 36,000 deaths (90% in those >65 years of age)	Estimated deaths ➤ 209,000–1.9 million in the US ➤ 50–81 million worldwide
Prevention: ➤ Competent vaccine ➤ Good hygiene practices	Spread of the disease halted or attenuated through: ➤ Contact and transmission interventions ➤ Antiviral drugs for prophylaxis and treatment

Table 24.1: Differences between seasonal and pandemic influenza

little or no immunity; it may be caused by either swine or avian flu viruses.³ The differences between pandemic and seasonal influenza are outlined in Table 24.1.

Both epidemics and pandemics require the presence of: (1) a disease agent; (2) a vehicle that facilitates large-scale transmission (such as contaminated food or water); and (3) a susceptible population. Interventions target one or more areas of the disease triad. Historically, influenza pandemics are different in that they occur in two or more waves; its initial occurrence in spring is less virulent than its second occurrence, usually six weeks to two months later.^{3,6}

HISTORY OF PANDEMICS

Influenza pandemics occur rarely and unpredictably. In the last 100 years, there have been three pandemics that have had components of Influenza A avian viruses (Table 24.2). The 1918 flu resulted in the greatest infectivity, morbidity, and mortality, affected persons between the ages of 18 and 42 years, and resulted in >40 million deaths (case fatality rate of 2%).¹³ The average time from the onset of symptoms to death was <12 hours.⁶ It is believed that the severity and the mortality associated with the disease in young infected persons was due to an excessive immune response, resulting in tissue damage and rapid fluid shifts causing pulmonary edema and a respiratory distress syndrome.¹⁴ The influenza pandemics in 1957 and 1968 affected and killed fewer persons because the causative agents consisted of previously circulating H5N viruses, to which some of the population had prior exposure and, therefore, immunity.¹³

Originally, the WHO classified the probability that a pandemic will occur into six alert phases ranging from Phase 1 — a new virus subtype with low capability of causing disease in humans — through Phase 6 — a pandemic phase with increased and sustained transmission in the general population. The US government uses six corresponding stages ranging from Stage 0 — new domestic animal outbreak in an at-risk country — to Stage 6 — recovery and preparation for subsequent waves of the disease (Table 24.3).¹⁵ Since the emergence of the 2009 H1N1, the WHO has revised its system to reflect the geographic mobility of disease transmission, with less emphasis on the number of deaths (Table 24.4).¹⁶ In both classification systems, the declaration of

YEAR	ESTIMATED US DEATHS	ESTIMATED WORLDWIDE DEATHS	INFLUENZA A STRAIN	POPULATIONS AT GREATEST RISK
1918–1919	500,000	40 million	H1N1	Young, healthy adults
1957–1958	70,000	1–2 million	H2N2	Children; elderly
1968–1969	34,000	700,000	H3N2	Infants; elderly

Table 24.2: History of pandemics by deaths, causative strain and at-risk populations

a pandemic is based on the emergence of clusters of ill persons and the identification of a mutated virus that is capable of efficient human-to-human transmission. It is important to recognize that the phases and stages of a pandemic may not progress sequentially, as the development of an efficiently transmitted virus may begin anywhere in the world.

Influenza symptoms in humans have included body aches, headache, runny nose, sore throat, cough, difficulty breathing, clinical or radiographic findings

WHO PHASES		FEDERAL GOVERNMENT RESPONSE STAGES	
Inter-pandemic Period			
1	No new influenza virus subtypes have been detected in humans. An influenza virus subtype that has caused human infection may be present in animals; the risk of human disease is considered to be low.	0	New domestic animal outbreak in at-risk country
2	No new influenza virus subtypes have been detected in humans. However, a circulating animal influenza virus subtype poses a substantial risk of human disease.		
Pandemic Alert Period			
3	Human infection(s) with a new subtype, but no human-to-human spread or, at most, rare instances of spread to a close contact.	0	New domestic animal outbreak in at-risk country
		1	Suspected human outbreak overseas
4	Small cluster(s) with limited human-to-human transmission but spread is highly localized, suggesting that the virus is not well adapted to humans.	2	Confirmed human outbreak overseas
5	Larger cluster(s) but human-to-human spread is still localized, suggesting that the virus is becoming increasingly better adapted to humans, but may not yet be fully transmissible (substantial pandemic risk).		
Pandemic Period			
6	Pandemic phase: increased and sustained transmission in general population	3	Widespread human outbreaks in multiple locations overseas
		4	First human case in North America
		5	Spread throughout United States
		6	Recovery and preparation for subsequent waves

US Government. Available at www.pandemicflu.gov/plan/federal/fedresponsestages.html

US Government. Available at www.pandemicflu.gov/plan/federal/fedresponsestages.html

Table 24.3: A comparison of original WHO Pandemic Phases and the US government's Response Stages

of pneumonia, and fever $>38^{\circ}\text{C}$.¹⁷ However, the symptoms associated with a pandemic influenza virus may change once the virus mutates into a form that is capable of sustained, efficient, person-to-person transmission. Once this occurs, a specific case definition describing the viral syndrome can be developed. Case definitions usually include: age group, gender, occupation, race, geographical location, illness onset, clinical features, and laboratory criteria. Risk groups cannot be predicted reliably until the pandemic virus emerges, but, in general, are likely to include infants, the elderly, pregnant women, and persons with chronic or immunosuppressive medical conditions.¹⁸

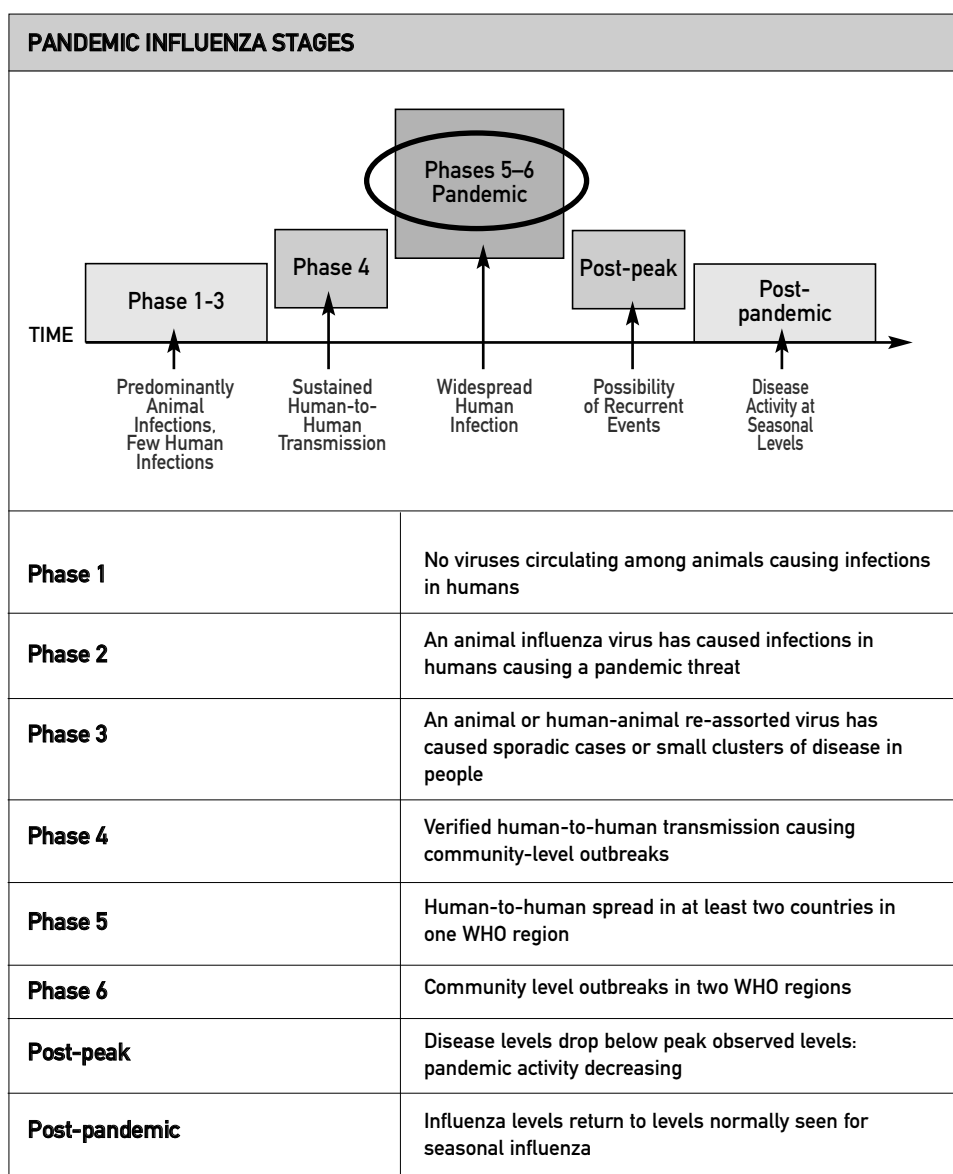


Table 24.4: The revised WHO phases of pandemic alert

CHARACTERISTICS AND CHALLENGES OF A PANDEMIC

Rapid Worldwide Spread

The spread of an emerging pandemic virus around the world is inevitable and disaster preparedness planners must assume that all populations are at risk. During previous pandemics, the virus traveled throughout the world in less than one year. Many countries may adopt containment measures, such as border closures and travel restrictions, to limit and delay the arrival of the virus. Although these measures may impede the arrival of the virus to some extent, they will not stop it entirely. Unlike other emergencies, most locations will be affected simultaneously, and resources will not be able to be distributed geographically.¹⁹

Overloaded Healthcare Systems

Healthcare systems in most countries provide “just-in-time” healthcare to maintain the greatest financial efficiency. For example, in the United States, the numbers of hospitals, hospital beds, and emergency rooms have decreased in recent years, leaving little surge capacity. Thus, on average, US hospitals have a 97% occupancy rate; 69% of urban, and 33% of rural hospital emergency departments report being at or over capacity; and 70% of urban and 74% of teaching hospital emergency departments are “on diversion” (i.e., needing to divert patients to another hospital) for some period of time during the year.²⁰ Of the 159,600 hospital beds in the United Kingdom, the average occupancy rate is approximately 85%.⁷ The Institute of Medicine found that many US hospitals already are at, or near, full capacity and are not equipped to respond to the increased demand and decreased resources that would occur during a mass-casualty event, such as a pandemic.²¹ During 2003 and 2004, it is estimated that there were approximately 97,600 critical care beds, 54,400 mechanical ventilators, 31,200 negative pressure isolation rooms, and 64,500 personal protective suits available in the United States.²²

Worldwide, there is a shortage of healthcare professionals, especially registered nurses. Fifty-seven countries, including 36 in Africa, are experiencing a critical shortage of nurses.²³ Less than half of US hospitals have emergency/disaster plans that include additional staffing or incentives or provisions to encourage healthcare workers to report to work during emergencies, such as mass-casualty events or major infectious disease outbreaks.²⁴ In a long-term pandemic event, the influx of patients, coupled with the limited ability of most hospitals to expand their staff or their treatment space, will overload healthcare systems rapidly. Vulnerable populations may be left without effective access to necessary health care.

Inadequate Medical Supplies

Because the H5N1 and H1N1 viruses continue to mutate, and have not yet emerged as viruses that are capable of sustained efficient human-to-human transmission, there currently is no available vaccine against them.^{25,26} However, vaccines against the H1N1 virus are being developed. In the initial stages of a pandemic, there may be insufficient antiviral drugs, which will contribute to increased hospitalizations and requirements for medical care and supplies for the treatment of infected persons. From a survey of pandemic flu preparedness, 79% of US hospitals are likely to run out of supplies in <1 week; 54% of hospitals could continue functioning for only one to three days without external resources; and 25% could function four to seven days without external resources.²⁷ In a severe pandemic, there will be insufficient beds, supplies, and trained staff for the care of patients in the traditional way.²⁸

Economic and Social Disruptions

A worldwide influenza pandemic could have major effects on the global economy, especially travel, trade, tourism, food consumption, and, eventually, investment and financial markets. During a pandemic, an estimated 40% of workers will be absent due to personal illness, the need to care for sick family members, and/or the fear of exposure; this will cause substantial economic disruptions.¹⁹ In Southeast Asia, the ongoing viral outbreaks that began in late 2003 and early 2004 have been disastrous for the poultry industry in that region; by mid-2005, >140 million birds had died or been destroyed, and losses to the poultry industry are estimated to be >US\$10 billion.²⁹ An unmitigated pandemic could cost the global economy as much as US\$800 billion per year.³⁰

Unpredictable Casualty Estimates

Possible morbidity and mortality estimates of a global pandemic differ immensely, and reflect the difficulty of reliably predicting its health consequences. Estimates of the number of influenza-related deaths in the United States range from 209,000 deaths in a moderate pandemic (similar to the pandemic in 1958) to >1.9 million deaths in a severe pandemic (similar to the pandemic in 1918).²⁴ Based on mathematical modeling using a 50% influenza attack rate and a 2.5% fatality rate, an estimated 1,250 persons/100,000 people will die from influenza-related causes in the UK alone.⁷ Using information from the 1918 pandemic, Murray and others estimate that 51 to 81 million deaths could occur worldwide from a global influenza pandemic!³¹

PLANNING AND PREPAREDNESS

An influenza pandemic is an international public health emergency requiring that countries and international bodies work together to coordinate surveil-

lance, planning, research, vaccine development, and response. The WHO is the United Nations (UN) specialist agency for health; it coordinates international surveillance, investigation, and response through its Global Influenza Programme. The WHO also provides information, technical standard-setting documents, a checklist for national preparedness plans, field assistance to member states, international leadership, as well as advocacy and advice to health authorities, the media, and the public. The WHO has produced a pandemic influenza preparedness and response guidance document and checklist (available at www.who.int/csr/disease/influenza/PIPGuidance09.pdf and www.who.int/csr/resources/publications/influenza/FluCheck6web.pdf).³² Current WHO pandemic planning is based on early efforts to contain a pandemic virus by delineating a specific geographic area around the disease, and aggressively treating infected individuals as well as those exposed to the disease.³³ Such a “ring strategy” is similar to plans used to contain the smallpox virus. This strategy requires that infected persons and their close contacts be restricted from leaving a defined area while being treated aggressively with anti-viral drugs to prevent or lessen the burden of disease. As part of the WHO plan, travel to and from an affected area likely will be restricted temporarily.³³ For example, persons attempting to leave an infected area likely will be interviewed, and, if necessary, quarantined for a period to ensure that they are not infected or actively shedding virus before they are allowed to leave. Temporary restrictions on international travel may be imposed. Healthcare providers near major transportation hubs (especially international airports) may incur additional work requirements in order to assess and care for travelers placed on temporary travel restriction.

However, such containment efforts were not successful with the 2009 H1N1.³⁴ By the time that the virus was detected, persons had already traveled to other nations infecting others. The WHO Director General, Margaret Chan, has stated “once a fully fit pandemic virus emerges, its further international spread is unstoppable.”³⁴

Isolation or quarantine for a period of time that exceeds the incubation period of the virus may be necessary to prevent the emergence of new cases. Isolation can be enforced legally through existing laws and regulations by the local health authority. The current US government plan is to ask citizens to quarantine themselves at home voluntarily to contain the virus.³⁵

In the United States, federal pandemic planning and preparedness goals are focused on three specific areas: (1) stopping, slowing, or otherwise limiting the spread of a pandemic to the United States; (2) limiting the domestic spread of a pandemic in order to reduce associated suffering and death; and (3) sustaining infrastructure, mitigating the economic impact to the economy, and maintaining the functioning of society.³⁶ Planning in the United States is based both on

the 2005 National Strategy for Pandemic Influenza³⁴ and the 2006 Implementation Plan for the National Strategy.¹⁸ The Implementation Plan translates the National Strategy into more than 300 actions for federal departments and agencies, setting clear expectations for state and local governments and other non-federal entities with established assumptions intended to standardize planning efforts.¹⁹ Some examples of planning assumptions are:

- Susceptibility to the pandemic influenza virus will be universal;
- The clinical disease rate will be approximately 30% in the overall population; illness rates will be highest among school-age children (about 40%), and decline with increased age;
- Some persons will become infected but not develop clinically significant symptoms. Asymptomatic or minimally symptomatic individuals can transmit the virus and develop immunity to subsequent infection; and
- Epidemics will last between six and eight weeks in affected communities.

Several documents have been released to assist in standardizing preparedness as well as to encourage the early, uniform implementation of measures to take during community outbreaks. Two examples to guide healthcare providers are summarized below.

The *Guidance on Preparing Workplaces for an Influenza Pandemic* (available at www.osha.gov/Publications/influenza_pandemic.html) provides assistance to employers and employees in preparing for, and responding to, a pandemic influenza.³⁷ It establishes four exposure risk levels (very high, high, medium, and low) of potential exposure to influenza in the workplace and recommends control strategies for each level of risk. For example, it defines high risk as:

1. Healthcare delivery and support staff exposed to known or suspected infected individuals (e.g., doctors, nurses, and other hospital staff);
2. Medical transporters of known or suspected infected patients in enclosed vehicles (e.g., emergency medical technicians); and
3. Persons who perform autopsies on known or suspected infected patients (e.g., morgue and mortuary employees).

The guidance recommends that persons considered to be at high risk wear respiratory protection, faceshields, gloves, and medical/surgical gowns or other disposable protective clothing (or clothing able to be decontaminated). Eye protection should be worn in situations in which splashes are anticipated.³⁷

The *Interim Pre-pandemic Planning Guidance: Community Strategy for Pandemic Influenza Mitigation in the United States — Early, Targeted, Layered Use of Non-pharmaceutical Interventions* (available at www.pandemicflu.gov/plan/community/community_mitigation.pdf) introduces the Pandemic

Severity Index which provides businesses and communities with a tool for scenario-based contingency planning to guide their pandemic preparedness efforts (Figure 24.1).³⁵ The index uses the fatality ratio as the critical driver for forecasting a pandemic's severity. An accompanying matrix is keyed to the severity index and summarizes recommended strategies for families, schools, and workplaces. For example, the guide recommends the voluntary isolation of ill persons at home in all severity stages (1–5), but recommends voluntary quarantine of household members in homes of ill persons during the most severe stages (4 and 5), and consideration of voluntary quarantine in stages 2 and 3. Social distancing, a combination of targeted and layered interventions

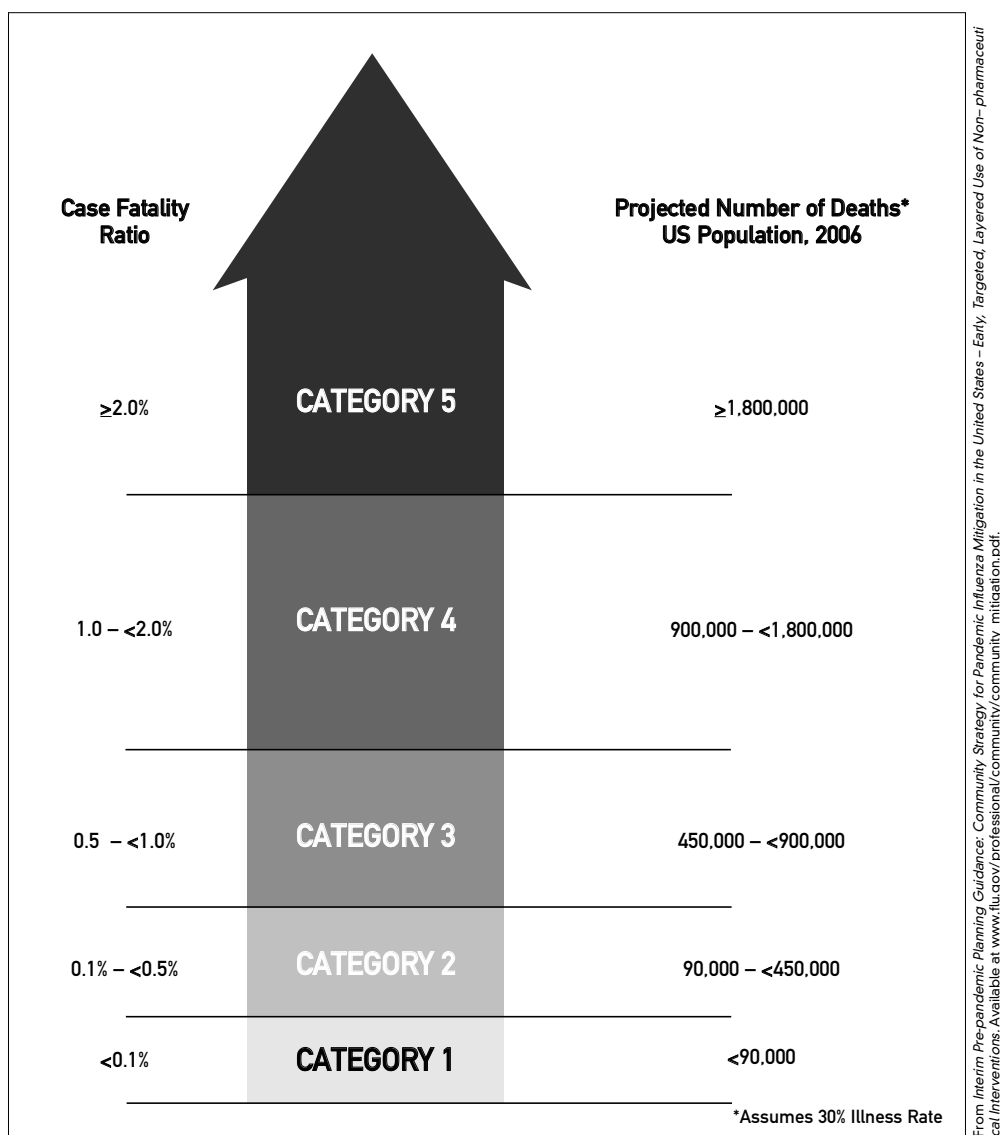


Figure 24.1: Pandemic Severity Index

designed to interrupt disease transmission, is introduced as a second concept. Social distancing measures could include: (1) decreasing the number of potential contacts with others; (2) decreasing physical contact with others (e.g., handshaking, hugging, and kissing); (3) increasing the distance between people to greater than 1–2 meters; (4) implementing alternatives to face-to-face contacts; (5) closing schools and day-care centers; and/or (6) cancelling all large public gatherings.³³ Similar recommendations are made in the UK Department of Health Pandemic Flu National Framework.⁷ The Pan-demic Severity Index was of little use during the 2009 H1N1 pandemic because the recommended actions are based on the number of fatalities, which were too low to be useful. Officials currently are re-evaluating the index to make it more sensitive to the needs of communities and businesses.

Healthcare Planning

Because of multiple interdependencies, healthcare planning requires coordination that begins with the development and sharing of pandemic contingency plans. It is essential that all plans (federal, state/province, local, and the private sector) be based on similar assumptions as well as operational thresholds and triggers. The sharing of plans helps to synchronize efforts as well as identify gaps in planning and response. In addition, hospitals must be prepared to scale down or expand certain healthcare activities in response to the changing dynamics of the evolving pandemic scenario.

Recognizing that healthcare staff may be disproportionately affected during a pandemic, some hospitals have established memoranda of understanding to allow for the sharing of personnel to address surge requirements. This requires that staff have a minimum level of similar training and credentialing. Additionally, healthcare systems, already facing significant shortages of many types of providers, are examining methods of bringing unemployed or retired professionals back into the workforce as well as utilizing volunteers. Pandemic planning guidance for a variety of health organizations (hospitals, clinics, and offices) can be found on the US government pandemic Website at www.pandemicflu.gov/plan/healthcare/index.html.³⁸ The guides and checklists provide detailed information on healthcare-related pandemic planning. Additionally, the site includes a toolkit with resources and information for clinicians to use in discussing pandemic influenza with patients and in providing care. Guidelines include interim community mitigation recommendations, pandemic influenza preparedness, and response guidance for healthcare workers and healthcare employers, including planning guides for mass medical care with scarce resources.

Faced with providing care to large numbers of ill persons, hospital capacity may become overwhelmed. Some communities have plans to deliver care at

alternate care sites, such as schools, gymnasiums, armories, or convention centers. This planning is intended to manage outpatient influenza cases and reduce the disease progression to severe disease requiring inpatient care. Levels of care provided at alternative care sites may vary from simply providing a location for self-care for persons without a support system in the community, to providing basic and essential medical care.³⁹ Some alternate care options include:

1. Telephone hotlines — staffed, call-receiving facilities that provide advice 24 hours/day, 7 days/week, on whether symptomatic individuals should stay home or seek medical care, and offer self-care strategies. Hotlines may be staffed by trained lay operators who follow clinically approved algorithms;
2. Telephone monitoring — frequent telephone calls to persons living alone or with fragile support systems in order to monitor their health status;
3. Designated influenza (also called “fever”) clinics — provide out-patient screening of persons with influenza symptoms and offer self-care strategies;
4. Alternate hospital triage sites away from the main hospital and ED, e.g., treatment of severely ill patients in areas of a hospital not normally used for acute care by medical and nursing staff who do not normally care for such patients; and
5. Home visits by healthcare professionals, community “visitors” (trained laypersons), or community-based health teams.

Additional information on alternate care sites can be found at www.ahrq.gov/research/altsites.htm.

Two computer programs are available to assist in pandemic planning efforts: (1) FluAid 2.0,⁴⁰ which is a free software program that provides estimates of potential outpatient presentations, hospitalizations, and deaths that may occur based on local demographics provided by the user; and (2) FluSurge 2.0,⁴¹ which is a software program that calculates the potential demand for general hospital beds, intensive care beds, and mechanical ventilators for each week of the pandemic, and then compares the estimated demand with actual capacity.

The healthcare community must be prepared for any emergency, including a pandemic. We must help the general public learn what they can do to prevent disease transmission in their homes and workplaces, as well as throughout the community. Pandemic educational materials should be language-specific, reading-level appropriate, culturally sensitive, and include information on the: (1) prevention and control of influenza; (2) implications of pandemic influenza; (3) benefits of annual influenza vaccination; and, (4) the role of antiviral drugs.⁴²

Vaccine Development

A pandemic will end when the majority of the population becomes immune to the virus, either through acquiring and surviving the disease, or through the use of effective vaccination. Both strategies result in a non-susceptible host. Viral-specific vaccines are the means of providing passive immunity. However, currently, no specific H1N1 influenza vaccine is available.^{25,26} Several vaccines are under development and may provide varying degrees of efficacy (protection) until a precisely matched vaccine can be produced. Since a pandemic virus recently has emerged and its characteristics are known, samples of the virus causing the pandemic are being used to develop a specific vaccine. Using current vaccine manufacturing technology, it will take approximately 20–22 weeks to begin to produce small quantities of a matched vaccine, and could take up to four years to produce sufficient quantities of the specific vaccine to immunize the 6.7 billion people of the world with two doses.⁴³ When H5N1 was considered to be the emerging pandemic, manufacturers rushed to develop small quantities of pre-pandemic vaccines using early versions of the H5N1 virus. Pre-pandemic vaccines have unknown effectiveness against emerging pandemic strains.³⁵ It has been suggested that the most likely use of a pre-pandemic influenza vaccine strain would be as the first of a two-part “prime-boost” vaccination series intended to activate an immune response in a naive individual.⁴⁴ However, these pre-pandemic vaccines do not match the genetic sequencing of the H1N1 virus and, therefore, are of no utility against this virus.

The United States has established recommendations for vaccination priority groups.^{26,45} During a pandemic, these recommendations will be updated, based on the characteristics of the virus, and the identification of at-risk populations, including personnel who perform functions essential to maintaining continuity of operations (e.g., healthcare personnel, fire, police, and water and electrical power workers).

Antiviral Agents

In the absence of vaccines, planners are purchasing and stockpiling antiviral agents. Antiviral drugs work either by preventing the intrusion of viral particles into a cell or by preventing replicated viruses from leaving the cell. The four antiviral drugs currently approved by the US Food and Drug Administration (FDA) for the prevention and/or treatment of influenza include amantadine, rimantadine, oseltamivir, and zanamivir. However, the use of amantadine and rimantadine should be avoided because of the high incidence of resistance associated with their use.⁴⁷ Both of the neuraminidase inhibitors, oseltamivir (commercially known as Tamiflu®) and zanamivir (commercially known as Relenza®) are most effective in treating influenza when taken shortly after the onset of illness (e.g., within 48 hours of symptom onset). Both of these pre-

scription drugs have been shown to decrease the duration of flu symptoms by 1–1.5 days. Oseltamivir is in capsule form, while zanamivir is a powder that is inhaled; both are taken twice each day for five days when used for treatment. Adults should receive a 75 milligrams capsule of oseltamivir every 12 hours. Children weighing <23 kilograms require a weight-related dose of oseltamivir according to the manufacturer's directions. On 27 April 2009, the US FDA issued an emergency use authorization for the use of oseltamivir in children under the age of one year.^{48,49}

Antiviral drugs also can be given prophylactically to prevent infection either before or after a person is exposed to the influenza virus. Post-exposure prophylaxis is given within 48 hours of an exposure, usually to individuals within close contact, or to entire households in which a member is infected with the virus. The treatment consists of one dose of either oseltamivir or zanamivir daily for 10 days. Current US guidelines support pre-exposure or outbreak prophylaxis for the duration of a community outbreak for frontline healthcare providers and emergency services personnel deemed to be at high or very high risk of infection.⁵⁰ Frontline personnel include emergency medical services (EMS) personnel, firefighters, and law enforcement personnel. Recommendations are to provide each frontline individual with up to eight antiviral treatment regimens (i.e., 80 doses, or 1 dose/day x 10 days x 8 regimens). However, prophylaxis provides protection only as long as the individual is taking the antiviral drug, which may be insufficient given the estimates of 12–18 weeks for the duration of one pandemic wave.⁵¹

While there is no US recommendation for prophylactic treatment of critical infrastructure workers outside of the healthcare and emergency services sectors, it is strongly suggested that employers involved in essential community services consider prophylactic treatment plans to ensure that critical services are not disrupted by worker absences during a pandemic.⁵⁰

As mentioned, recent reports indicate that H1N1 resistance to oseltamivir is rising both in the United States as well as globally, increasing from 11% in 2008, to 99% in 2009 in seasonal influenza samples analyzed by the US Centers for Disease Control and Prevention (CDC).^{52–54} The reason for this rapid increase in resistance to oseltamivir is unknown, especially in countries where antiviral drugs rarely are used. One hypothesis is that the drug is not broken down by sewage treatment systems and is being discharged into rivers and streams where waterfowl that carry the disease may come in contact with the drug.⁵⁵

To date, there have been two 2009 H1N1 patients showing resistance to oseltamivir, one in Denmark and one in Japan.^{56,57} The first case, found in Denmark where oseltamir rarely is used, prompted concerns about the virus becoming resistant to antiviral drugs.

An important consideration regarding stockpiles of oseltamivir or zanamivir is the limited shelf-life (five to seven years) of these agents necessitating a replacement or rotation of stockpiles. Some countries in endemic areas report that their stockpiled drugs are beginning to expire.⁵⁸ Several strategies to mitigate shelf-life issues have been suggested; for example, some drug manufacturers have developed programs whereby, for a fee, they hold specific quantities of in-date drugs.⁵⁰

Although antiviral drugs can shorten the duration of influenza and decrease or prevent complications, decrease the spread of disease, and lessen the burden on a community during a pandemic, their use comes with legal, ethical, regulatory, logistical, and economic implications. Thus, these agents should be considered as only one of many tools used in addressing an influenza pandemic.⁵⁰

Transmission Control Measures

Vaccines and antiviral drugs likely will not be sufficient to slow or prevent a pandemic influenza. Non-pharmaceutical interventions, including social distancing and infection control, are essential additional control measures. *Social distancing* refers to measures to limit the amount of virus to which a person is exposed; it includes increasing the distance between people and limiting personal contacts. Specific examples of social distancing include: maintaining 1–2 meters of space from the next person; suspending large public gatherings; and closing day-care facilities, schools, colleges, and universities for up to 12 weeks, depending on the severity of the pandemic.³⁸

Infection control measures include hand hygiene, cough etiquette, use of personal protective equipment (PPE), disinfection, and environmental controls. While a complete description of standard precautions is beyond the scope of this chapter, some practices related specifically to pandemic influenza are discussed below.

Numerous studies have demonstrated that hand washing is the single most important infection control practice.^{59–62} Because the Influenza A virus contains a lipid layer on its outermost coat, hand washing with soap and water for 15–20 seconds can remove the virus from hand surfaces. When soap and water are not available or practical, an alcohol-based hand wipe or gel (60–65% alcohol) may be substituted.^{63–65} Hand washing should be done at frequent intervals, especially before and after all contact with patients; before and after donning gloves; after coming into contact with nasal secretions; after touching the nose, mouth, or eyes; or after coming into contact with surfaces that are touched frequently, such as doorknobs, bathroom surfaces, keyboards, telephones, or elevator buttons.⁶⁴

Cough etiquette includes those actions used to contain an infectious agent. It includes: covering the mouth and nose when coughing or sneezing; using dispos-

able tissues with proper disposal in no-touch containers; and frequent hand washing to prevent spreading an infection to others.³⁵ When tissues are not available, covering one's mouth and nose with the upper sleeve may be a safe alternative.

The use of personal protective equipment (PPE) should be tailored to the type of exposure risk.³⁷ Detailed guidance can be found at www.osha.gov/Publications/influenza_pandemic.html and www.cdc.gov/flu/professionals/infectioncontrol/pdf/flu-infectioncontrol-hcfacilities.pdf. For healthcare professionals caring for patients infected with influenza virus, PPE includes the use of standard barrier precautions (gloves, gowns), and droplet precautions (facemasks and protective eyewear), as well as other types of protective shields as warranted during certain procedures.⁶⁶

Surgical/procedure facemasks are loose-fitting disposable masks typically worn by healthcare workers during surgery and surgical procedures. They act as a barrier to splashes and large droplets transmitted by patients' coughing or sneezing; they *provide no respiratory protection* to the user. Respirators (e.g., N95) also are facemasks that are fitted to cover the nose and mouth and form a tight seal on the face. The composition of these masks allows them to filter approximately 95% of particles >0.3 microns, which reduces the wearer's risk of inhaling airborne particles.⁶⁶ Some filtering, facepiece respirators have an exhalation valve that can reduce breathing resistance, reduce moisture build-up inside the respirator, and increase comfort for respirator users. For the N95 respirator to be an effective barrier, it is essential that it fit snugly, yet comfortably, on the face; adjustments can be made using the attached straps. The N95 respirators are not designed for use by children or people with beards. The US Department of Occupational Safety and Health Administration (OSHA) mandates that personnel likely to use N95 respirators undergo fit-testing, which involves selecting the correct size and type of respirator (mask) for each worker, and ensuring that he/she knows how to use it correctly. An updated model of the N95 mask, the NBW95, is designed to fit a variety of face shapes and sizes. The advantages and disadvantages of various respirators and masks are listed in Table 24.5.

Healthcare workers coming in contact with patients suspected of having avian influenza should use additional precautions (such as those used for Severe Acute Respiratory Syndrome [SARS], including airborne precautions and eye protection) because of the uncertainty of the mode of transmission between humans and its high pathogenic nature.⁶⁷

Studies of the SARS outbreak in multiple countries in 2003 have provided valuable information regarding the effects of infection control practices and PPE use among healthcare workers during a pandemic. Although SARS predominantly is spread by large respiratory droplets, there is evidence to suggest an airborne transmission of the disease.⁶⁸ In the various countries affected by SARS, the protection worn by healthcare workers caring for

DEVICE	ADVANTAGES	DISADVANTAGES
Facemasks (surgical masks)	➤ Reduces exposure to splashes of large droplets ➤ Tested for fluid resistance ➤ Easier to breathe through than a respirator	➤ Cannot be decontaminated ➤ May be shortages during a pandemic ➤ Not designed to form a seal on the face ➤ Do not reduce exposure to small inhalable particles
N95 Respirator (filtering facepiece)	➤ Reduces exposure to small inhalable particles and large droplets ➤ Designed to form a tight seal on the face ➤ Certified filtration efficiency	➤ Cannot be decontaminated ➤ May be shortages during a pandemic ➤ Must be fit-tested to assure full protection ➤ Cannot be worn with facial hair that interferes with the seal between the face and respirator ➤ Harder to breathe through than a facemask ➤ Not designed to be used in surgery
N95 Respirator w/exhalation valve (filtering facepiece)	➤ Reduces exposure to small inhalable particles and large droplets ➤ Designed to form a tight seal on the face ➤ Certified filtration efficiency ➤ Exhalation valve makes it easier to exhale and reduces moisture build-up inside the facepiece compared to other filtering facepiece respirators	➤ Cannot be decontaminated ➤ May be shortages during a pandemic ➤ Must be fit-tested to ensure full protection ➤ Cannot be worn with facial hair that interferes with the seal between the face and respirator ➤ Harder to breathe through than a facemask ➤ Should not be used when others must be protected from contamination by the wearer ➤ Not designed to be used in surgery
Surgical Respirator (filtering facepiece)	➤ Reduces exposure to small inhalable particles and splashes of large droplets that would require a facemask ➤ Designed to form a tight seal on the face ➤ Certified filtration efficiency ➤ Tested for fluid resistance, bio-compatibility, and flammability	➤ Cannot be decontaminated ➤ May be shortages during a pandemic ➤ Must be fit-tested to assure full protection ➤ Cannot be worn with facial hair that interferes with the seal between the face and respirator ➤ Harder to breathe through than a facemask ➤ Limited availability compared to other filtering facepiece respirators
Elastomeric Respirator (flexible, rubber-like facepiece)	➤ Reduces exposure to small inhalable particles and large droplets ➤ Designed to form a tight seal on the face ➤ Filtration efficiency certified ➤ Can be decontaminated and reused, therefore can reduce/eliminate the impact of potential N95 shortages ➤ Higher initial cost, but may be more cost effective than filtering facepieces for long-term use ➤ Filters are replaceable ➤ After decontamination, respirators can be used by different individuals ➤ Full facepiece type provides eye protection ➤ Full facepiece type provides a higher level of protection than does a half face-piece type	➤ Must be fit-tested to ensure full protection ➤ Cannot be worn with facial hair that interferes with the seal between the face and respirator ➤ Harder to breathe through than a facemask ➤ May interfere with voice communication ➤ Requires cleaning and disinfection between uses ➤ Should not be used when others must be protected from contamination by the wearer
Powered Air-Purifying Respirator (PAPR) (head/face covering with battery-powered blower unit)	➤ Reduces exposure to small inhalable particles ➤ Provides greater level of protection than filtering facepiece or elastomeric respirators ➤ Certified filtration efficiency ➤ Can be decontaminated and reused, therefore can reduce/eliminate the impact of potential N95 shortages ➤ Hooded PAPRs do not need to be fit-tested and can be worn with facial hair ➤ Reduces/eliminates breathing resistance and moisture build-up inside the facepiece/hood ➤ Filters are replaceable ➤ After decontamination, PAPRs can be used by different individuals ➤ Full facepiece type provides eye protection	➤ Substantially more expensive than other respirators ➤ Blower unit/battery typically worn on belt weighs 1.5–3 lbs (0.7 – 1.4kg) ➤ On some units, fan noise can make communication and medical care delivery more difficult ➤ Requires cleaning and disinfection between uses ➤ Should not be used when others must be protected from contamination by the wearer

Table 24.5: Advantages and disadvantages of respirators and facemasks⁷⁸

infected patients was inconsistent; some wore complete PPE including N95 respirator masks, while others wore PPE that included only surgical/procedural masks. Although several studies failed to demonstrate a statistically significant difference in the incidence of SARS infection in healthcare workers who wore the N95 masks compared to those who wore the surgical masks, there was a trend showing increased protection with the use of the N95 masks compared to the surgical masks.^{69–71} Those care activities that were associated with a high incidence of SARS among nurses included intubation, suctioning, and manipulation of infected patients' oxygen masks.⁷⁰ Basically, those care activities that caused the generation of aerosols were most threatening to the health of the care providers. One study found that the inconsistent use of PPE, rather than the particular mask used, was associated with a significantly higher risk for developing SARS.⁷¹ Clearly, compliance with recommended PPE use is an issue that is of major concern during a pandemic. In one study of healthcare workers in the intensive care units of two hospitals, only 62% of the participants reported a high adherence rate (>80%) with the recommended PPE when caring for critically ill patients with influenza.⁷² Challenges faced by healthcare workers wearing full dermal and respiratory protection (respiratory masks) include impairment of verbal communication, loss of tactile sensation, physical discomfort, and difficulty breathing. The efficacy and disadvantages of other protective equipment, such as eye shields, have not been investigated.

The US OSHA has proposed guidance on the use of respirators and face-masks (available at www.osha.gov/dsg/guidance/stockpiling-facemasks-respirators.html).⁷³ This document recommends the use of N95 or higher grade respirators for employees who are at high or very high risk, and surgical face-masks for employees considered to be at medium risk. These categories are defined as follows:

- *Very High Exposure Risk* employees include doctors, nurses, paramedics, emergency medical technicians, dentists, and any providers performing aerosol-generating procedures on known or suspected infected patients; and healthcare or laboratory personnel who collect or handle respiratory tract specimens from known or suspected infected patients;
- *High Exposure Risk* employees include healthcare providers and support staff exposed to known or suspected infected patients (doctors, nurses, and other hospital staff that must enter patients' rooms); staff transporting known or suspected infected patients; and staff performing autopsies on known or suspected infected patients;
- *Medium Exposure Risk* employees include those with high-frequency contact with the general population (such as schools

- and work environments with high population density); and
- *Low Exposure Risk* employees include those who have minimal occupational contact with the general public and other employees (for example, office employees).

Cleaning of the contaminated environment can be accomplished by removing soiled and organic matter from surfaces followed by cleaning with soap or a detergent in water.⁶⁴ Detailed guidance for cleaning surfaces in healthcare facilities can be found at www.cdc.gov/ncidod/dhqp/gl_environ_infection.html.⁷⁴ This document, in part, recommends frequent cleaning and disinfection of routinely touched surfaces, at least daily cleaning of large surfaces, and avoidance of methods that produce mists or aerosols or disperse dust. When indicated, environment cleaning should be accomplished using proper concentrations of disinfection products following the recommended contact time. The US Environmental Protection Agency has registered >400 disinfectants that are capable of inactivating human influenza A and/or B.⁷⁴ A complete list of cleaning agents can be found at www.epa.gov/oppad001/chemregindex.htm.⁷⁵

Other environmental controls that limit the transmission of diseases include: (1) admitting patients either to a single-patient room or cohorting patients with the same organism; (2) closing doors within the facility to limit entry and exit; and (3) performing aerosol-generating procedures in negative-pressure airborne isolation rooms, private rooms, or in rooms with high efficiency particulate air (HEPA) filters.⁷⁴

Other measures to ensure a culture of safety in healthcare facilities include quarantine, temperature checks on hospital employees, triage screening, visitor restrictions, hospital closures, vaccination with seasonal human influenza vaccine, and infection prevention and infection control education of healthcare providers.⁷⁴

Supplies

Consumable resources, especially gloves and masks, may be in short supply during a pandemic. Healthcare organizations are encouraged to consider stockpiling enough consumable resources for the duration of a likely infection period (six to eight weeks). Examples of consumable supplies include: hand hygiene supplies (soap and alcohol-based hand sanitizers); surgical/procedural masks and N95 respirators; faceshields; gowns; gloves; facial tissues; intravenous and central venous cannulation supplies; and morgue packs. In one study, it was determined that hospital workers used approximately 20 sets of masks, gowns, gloves, and goggles for each infected patient within the first six hours of their hospitalization.⁷⁶ A second study found that, when implementing pandemic infection control guidelines, hospital workers used 10 times as

OCCUPATIONAL SETTING	PROPORTION OF MEDIUM- OR HIGH-RISK EMPLOYEES	NUMBER OF RESPIRATORS OR FACEMASKS PER EMPLOYEE PER WORK SHIFT		NUMBER OF RESPIRATORS OR FACEMASKS PER EMPLOYEE FOR A PANDEMIC (120 WORK DAYS)	
		N95 Respirators (High or Very High risk)	Facemasks (Medium risk)	N95 Respirators (High or Very High risk)	Facemasks (Medium risk)
Healthcare hospital ^a	33%	4 ^b	0	480	0
Outpatient office/clinic	67%	4	0	480	0
Long-term care	25%	1	3	120	360
Home-healthcare	90%	2	4	240	480
EMS	100%	8	0	960	0
First responders:					
➤ Law enforcement	90%	2	2	240	240
➤ Corrections	90%	1	3	120	360
➤ Fire department (non-EMS, career and volunteer)	90%	2	2	240	240
Medium-risk employees	See ^c	0	2	0	240

Table 24.6: Stockpiling estimates for respirators and facemasks⁷⁸

a. In hospital settings, it is expected that known or suspected pandemic influenza patients will be cohorted (i.e., infected patients share rooms only with other like-infected patients in order to reduce the exposure risk to non-infected patients).

b. Four respiratory protection devices per shift is the estimate used for most healthcare and emergency response settings. Assumptions: employees are in contact throughout the shift with pandemic influenza patients and have regular breaks.

c. Includes employees in various retail and other settings where it is not possible to avoid frequent and close contact with other people, whose pandemic infection status is unknown.

many gloves, created three times as much clinical waste, and spent more time than usual in performing care activities.⁷⁷

Recommendations for the stockpiling of masks and respirators also are provided by OSHA and listed in Table 6.⁷⁸ This document provides methods for estimating the quantities of masks and respirators that should be stockpiled. In the absence of data regarding either safe reuse or decontamination, and when supplies are limited, OSHA recommends that employers and employees could consider reuse if the device has no obvious damage or soiling.^{37,73}

Special Planning Considerations

Security

It is anticipated that anxiety, fear, and possibly panic may occur during large-scale public health emergencies. Because stockpile sites and healthcare facilities will be viewed as having potentially life-saving vaccines and antiviral agents as well as treatment options, additional security may be needed.⁵¹ This

is of particular concern when critical supplies, such as food or drugs, are moved from one location to another.

Special or Vulnerable Populations

During a pandemic, certain populations may be at higher risk than the general population, requiring communities to pre-identify them and to develop special plans for them. The characteristics of a special population may include persons who are highly susceptible to disease, require special approaches to care, have difficulty with access to care, or who lack support systems. Examples include: individuals with disabilities; children; the elderly; persons who are immunocompromised; the chronically ill, particularly those with chronic respiratory illnesses; people who live alone; the homeless; the homebound; poor or working poor individuals; recent immigrants; and persons who are institutionalized or incarcerated.^{33,79}

Ethical Considerations

Numerous ethical issues have emerged during discussions surrounding pandemic planning, including: (1) the prioritization and allocation of scarce resources,⁸⁰ such as ventilators,⁸¹ vaccines^{6,45} and antiviral drugs;^{45,50} (2) health-care workforce management (e.g., determining if healthcare workers will be mandated to come to work); (3) altered standards of care;⁸² (4) withdrawal or withholding of care;^{80–82} and (5) the enforcement of quarantine.⁸³ Each of these issues requires difficult decisions that ultimately may result in either the death or disability of large numbers of persons. Early consideration and open discussion of each of these ethical concerns will encourage decisions to be made in advance and communicated to the general public, thereby helping to establish expectations and manage specific challenges. Discussions should consider the greater good, how best to meet duties and obligations, short- and long-term consequences, and the fair and equitable access to and distribution of available resources. Discussions should be held in an open and transparent manner, include the views of stakeholders, and provide mechanisms for accountability.^{82,84} The WHO has developed detailed ethical considerations on setting priorities, disease control measures, the role and obligations of healthcare workers, and a multilateral response to pandemic influenza.⁸⁵

Recovery

Recovery begins following the completion of each pandemic wave with actions that are intended to restore the society to its pre-pandemic status, and must be based on the assessed physical, economic, and social impacts.¹⁹ For example, finding replacement workers for those who have died or are dealing with the challenges of illness or death will be difficult. Unlike most disasters, a portion

of the recovery effort must be directed to correcting shortages, replenishing supplies, and preparing for subsequent waves of the disease. Detailed recovery recommendations can be found at www.pandemicflu.gov/plan/pdf/CIKR_pandemicInfluenzaGuide.pdf.¹⁹

CONCLUSION

Although a pandemic cannot be prevented, its impact can be attenuated. Countries with well-developed health infrastructures and governmental and nongovernmental agencies involved in disaster planning and response have begun to address the health effects of a global influenza pandemic. Different regions of the world will have different experiences based on the level of planning in place.

While substantial planning and preparations for the next pandemic have been undertaken, when a pandemic first appears, there will not be a vaccine for it, and there may be insufficient antiviral drugs available. The healthcare system will be stretched beyond its limits and, as a result, many sectors of society will be affected. Stockpiling medications and equipment will be useless unless there is a system in place to deliver them rapidly, AND if those receiving them know how to use them efficiently and effectively.

We are not as prepared as we need to be. Healthcare providers and the general public must understand what lies ahead and how they can best protect themselves and their families. Understanding what constitutes being at risk during a pandemic, how transmission occurs, and what contact interventions will be in place allows individuals to understand better what will and will not be available during a pandemic, and, therefore, what plans they must make in order to ensure that they and their loved ones can be protected.

“CONVERSATIONS MUST OCCUR in which key members of the medical community are made to understand the full impact of a pandemic and realistically discuss the changes in health care delivery and management that will necessarily have to occur.”

Bernice Steinhardt
House of Representatives, Subcommittee on Emerging
Threats, Cybersecurity and Science and Technology,
Committee on Homeland Security, Washington, DC
27 September 2007

Author's Note

On 11 June 2009, the WHO declared a global pandemic based on the sustained human-to-human transmission of a novel and reassorted virus resulting in community-level outbreaks in multiple WHO regions.¹ The declaration was based on the rapid transmission of the disease, and not the number

of fatalities. As of 01 July 2009, the WHO reported more than 89,921 cases and 382 deaths in 120 countries.⁸⁶

To date, symptoms of this pandemic influenza A (H1N1) virus have been mild and include fever, cough, sore throat, runny or stuffy nose, body aches, headache, chills, and fatigue. Most of those infected have recovered without requiring medical treatment. Transmission has been rapid, making containment efforts futile. For example, cases of H1N1 influenza spread across the United States in <6 weeks despite aggressive efforts to mitigate the spread of the disease. The government recommended non-pharmacological measures, including increased hygiene (cough etiquette and hand washing) and disinfection measures, keeping ill people home, and school closures. The official count reached 22,902 cases and 170 deaths by 02 July 2009.⁸⁷ The US CDC estimates that more than 1 million US infections have occurred.⁸⁸ Clinicians are being urged to offer antiviral medications to persons with influenza-like symptoms who are at high risk without testing.

The novel H1N1 virus was first isolated in late April 2009 by US and Canadian laboratories after human cases occurred in Mexico, Southern California, and Texas, and continues to spread around the world. It is composed of genetic components of North American human, avian, and swine influenzas, as well as a Eurasian swine flu. There is no evidence that the virus has been circulating in North American animal populations, leading scientists to hypothesize that the infection was introduced to the continent and spread by humans not animals.⁸⁹

Characteristics of the virus, so far, vary only slightly among regions in the United States and in different countries.⁸⁸ In general, the virus is affecting people <50 years of age (80%), with the highest rates occurring in persons <25 years of age. The median age of hospitalized persons is 19 years, with the greatest number of deaths occurring in 37-year-old victims. Most (75%) of those who developed severe symptoms had an underlying condition, such as diabetes, heart disease, chronic lung disease, morbid obesity, or pregnancy.⁸⁸ Similar disease is occurring in the Southern Hemisphere, which is currently experiencing its flu season; a large number of cases of H1N1 influenza have been reported in Australia, Argentina, and Chile, where healthcare systems report difficulty in meeting the requirements created by the flu surge.⁸⁸ Scientists and government officials continue to monitor the situation to determine if the new H1N1 will re-assort with already circulating seasonal influenza viruses, and mutate into a more virulent and lethal form.⁹⁰

As of June 2009, H1N1 vaccine development and clinical trials are underway, although no decisions have been made to put the vaccine into use.⁸⁸ Triggered by the WHO's Phase 6 declaration to provide vaccine for their entire population, some countries, such as the United Kingdom, have advance

purchase agreements with vaccine manufacturers. They expect to have 132 million vaccine doses available within one year.⁹¹ In the United States, preparations are underway to deliver up to 600 million doses of H1N1 vaccine.⁹²

Finally, concerns for the safety of healthcare workers may be well-founded. In a CDC study of 48 healthcare workers with confirmed or probable H1N1 infections, 50% had acquired the infection in a healthcare setting. Most (85%) of those cases occurred because PPE was not used in accordance with H1N1 infection control recommendations.⁹³ These findings reinforce the need for healthcare workers to implement infection control recommendations to protect themselves from H1N1 transmission.

The information presented in this chapter has been verified up to the date of submission for publication; however, with an unfolding event such as a pandemic influenza, references and resources frequently change. Readers are encouraged to visit the US government's one-stop access portal for avian and pandemic influenza, located at www.pandemicflu.gov, for the most current information available.

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CHAPTER 25

HEALTH ISSUES IN HUMANITARIAN EMERGENCIES

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DURING A DISASTER of sizable proportions, there are pressing public health issues that, if not addressed immediately, can lead to high rates of associated morbidity and mortality. Nurses, as well as other healthcare workers, may be challenged to provide care in the difficulties of complex emergencies and large-scale disasters in developing countries.

OBJECTIVES:

- Understand the four major infectious disease processes encountered in refugee-causing emergencies;
- Describe the control measures necessary to prevent the spread of disease in a refugee settlement or campsite; and
- Discuss the role and importance of the needs assessment.

Aside from the expected injuries, people affected by disasters often suffer from malnourishment, stress, and fatigue. These conditions, coupled with sub-standard sanitation, inadequate water supplies, and poor hygiene make disaster-affected people especially vulnerable to disease. Food shortages in disaster situations contribute to acute malnutrition. The lack of safe drinking water can lead to exposure to many harmful agents, including hepatitis A, tuberculosis, giardia or parasitic helminthes.¹ Cholera and dysentery cause diarrhea, which, if left untreated, can result in severe dehydration and even death. Currently, diarrhea is the leading cause of death in children under five years of age in developing countries.²

When a disaster occurs, there is the potential for sanitation problems, inadequate shelter, lack of health care, communicable diseases, mental health issues, as well as sexual exploitation and violence against women and children.³ Finite

medical supplies become exhausted quickly leading to a scarcity of necessary items for adequate health care.

The health infrastructure of the affected region may be destroyed or severely affected during a disaster. Local infrastructure (such as bridges, roads, and electrical lines) also may be destroyed, further complicating healthcare delivery. Poor coordination of activities, overcrowding, displacement of populations, and potential epidemics (e.g., a measles outbreak) are additional factors that can compound the efforts of relief workers.

Events or situations may force groups of people to flee or to leave their homes or places of habitual residence and take shelter in transit camps. If these now homeless people remain within their country, i.e., they do not cross an internationally recognized border, they are referred to as *internally displaced persons* (IDPs). People who migrate across international borders are referred to as *refugees*. According to the UN Convention, a refugee is a person who is outside the country of his/her nationality and because of a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is unwilling to avail him/herself of the protection of that country and is unable or unwilling to return to it for fear of persecution.⁴ One major difference between IDPs and refugees is that refugees are protected by international law and are under the protection of the UN High Commissioner for Refugees, while IDPs are subject to the laws of their state and country. Thus, refugees receive benefits, such as healthcare services and safety, not provided to IDPs. In fact, in many instances, IDPs become victims of persecution and abuse by their own government and may suffer incredible human rights violations. When people flee their place of habitat (IDPs) and even their country (refugees) because of political unrest, violence, or armed conflict, it is referred to as a *complex emergency*. The UN Inter-Agency Standing Committee's official definition of a complex emergency is:

a humanitarian crisis in a country, region or society where there is total or considerable breakdown of authority resulting from internal or external conflict and which requires an international response that goes beyond the mandate or capacity of any single agency and/or the ongoing United Nations country program.⁵

Characteristics typical of complex emergencies include:

extensive violence and loss of life; massive displacements of people; widespread damage to societies and economies; the need for large-scale, multi-faceted humanitarian assistance; and, the hindrance or prevention of humanitarian assistance by political and military constraints.⁵

While, certainly, all disasters are complex, the term is used in this situation to highlight the particular complexity that is involved in providing

humanitarian assistance in politically unstable and armed conflict situations. It should be clear that providing aid in complex emergency situations differs markedly from providing aid in other situations, especially in terms of safety and security. This is particularly true today when most conflicts are intra-state (i.e., civil wars) involving segments of the population attempting to overthrow the government or establish a new, separate entity. This has substantial impact on the operations of international aid organizations.

RESPONSE AGENCIES

Internationally, there are numerous relief agencies that respond to all types of disasters. Non-governmental organizations (NGOs) are defined by their voluntary, independent, and not-for-profit status. They constitute the major component of the international aid system, and often specialize in one facet of disaster relief, e.g., food, health, or shelter. In 1994, more than 710 NGOs responded to a complex emergency in Haiti⁶ and, in the same year, 240 NGOs responded to the genocide crisis in Rwanda.⁷ There also are many agencies under the umbrella of the UN that become involved in complex emergencies and disasters, such as the United Nations Children's Fund (UNICEF) and the World Food Program (WFP).⁸ The United Nations High Commission for Refugees (UNHCR) coordinates international actions in support of refugees and aims to help refugees either return to their own country or assist them in permanent settlement at another location.

STANDARDS

In 1996, the Sphere Project was initiated by humanitarian NGOs and the Red Cross and Red Crescent to address the need to improve the quality of aid provided to people affected by disasters. The development of standards by the Sphere Project provides NGO workers with a universal code of conduct along with minimal professional standards to follow when providing relief work.⁹ These standards are the most widely used standards relative to humanitarian relief and refugee health work.

The Sphere Project is based on two core beliefs: (1) that all possible steps should be taken to alleviate human suffering arising out of calamity and conflict; and (2) that those affected by disaster have a right to life with dignity and, therefore, a right to assistance. The Sphere Project provides a handbook, which is the result of collaboration among response agencies and an expression of commitment to quality and accountability.⁹ The handbook includes a set of minimum standards and key indicators that provide guidance on different aspects of humanitarian action, and is designed for use in disaster response. It also may be useful in disaster preparedness and humanitarian advocacy. It is applicable in a range of situations in which relief is required, including disasters

due to natural hazards as well as armed conflict. The *Sphere Handbook* is available online at www.sphereproject.org/.

NEEDS ASSESSMENT

In the early days of a disaster, the urgent needs are to protect human life and health. Care should be prioritized and adapted to the needs associated with a specific disaster or complex emergency. Performing an initial needs assessment is crucial to meeting a population’s survival needs rapidly and effectively.

The initial needs assessment is conducted to provide information and recommendations that will guide the immediate response and the specific interventions provided by the responding agencies. It should be conducted by an experienced, multidisciplinary team of experts, and should include both the consequences of the event, as well as what is required to save lives, reduce suffering, and limit negative economic effects. This is achieved through interviews with local authorities, sample surveys of persons from the affected population, and the direct observations by the team. Key information about the affected population includes an estimation of the population size, the approximate number of victims, and information regarding the population’s culture. The information gathered also may identify vulnerabilities of the affected population.

Tables 25.1 and 25.2 outline the categories of data of the initial needs assessment according to Médecins Sans Frontières and the US Agency for International Development’s *Field Operations Guide for Disaster Assessment and Response*.^{10,11} The *Field Operations Guide for Disaster Assessment and Response* includes an Environmental Impact Assessment as part of its initial assessment data, and requires expanded data to be collected for displaced populations, as outlined in Table 25.3.¹¹

In a time of crisis or emergency, the public health system may be disrupted. In resource-poor countries, the local healthcare system may have been ineffective or even non-existent prior to the disaster-causing event. In order to determine the effects of a disaster on the affected population, the assessment

DATA CATEGORY
The geo-political context of the event
A description of the population
Characteristics of the refugee environment
Major health problems
The human and material resources required
Identification of the operating partners

Table 25.1: Initial needs assessment data according to Médecins Sans Frontières¹⁰

CATEGORY	DATA
Situation assessment	Number of people affected Mortality and morbidity rates Types of illnesses and injuries Population characteristics and condition Subgroups requiring special attention Emergency medical, health, nutritional, water, and sanitation conditions Existence of continuing or emerging threats Damage to infrastructure, critical facilities, homes, and businesses Damage to agriculture and food supply system Damage to economic resources and social organization Vulnerability to continuing or further impacts Level of response by affected country and internal capacities to cope Potential constraints or roadblocks to assistance Level and nature of ongoing or anticipated responses from others
Needs assessment	Priority and magnitude of response in each sector Type, duration, methods, and locations of assistance in each sector Degree and nature of potential local response

Table 25.2: Initial assessment data according to the US Agency for International Development *Field Operations Guide for Disaster Assessment and Response*¹¹

SECTOR/CATEGORY	DATA
General population characteristics	Numbers of men, women, and children Customs Language Capacities Assets

Table 25.3: General elements of data to be obtained in the assessment of displaced victims¹¹

team must gather information about the baseline health status of the community or population. The baseline rate of death or crude mortality rate (CMR) of the affected population provides a gauge of the community's overall well-being and is the most important indicator of serious stress and the state of health emergency.¹¹ If the baseline death rate of the population is unknown, and, thus, comparisons cannot be made between current and baseline rates, efforts should aim to maintain the CMR below 1.0 death/10,000 persons/day.¹¹ The average mortality rate of children <5 years of age is approximately 1.03 deaths/10,000 persons/day in most developing countries during non-emergency times.¹¹ A doubling of the community's baseline CMR in a disaster situation, or a CMR

that exceeds 1.0 death/10,000 persons/day, indicates an acute emergency requiring immediate intervention.¹² Figure 25.1 provides the method of calculating the crude mortality rate.

CRUDE MORTALITY RATE (CMR) CALCULATION	
CMR	$= \frac{(\text{Total deaths during time period}) \times 10,000}{(\text{Total population} \times \text{number of days in time period})}$
Example: 40 deaths in 2 weeks in a population of 30,000	
	$\frac{40 \text{ deaths} \times 10,000}{30,000 \times 14 \text{ days}} = 0.95 \text{ deaths/10,000 persons/day CMR}$
For children <5 years of age, CMR is calculated according to the existing population of children <5 years of age	
Example: 20 deaths in 2 weeks in a population with 10,000 children <5 years of age	
	$\frac{20 \text{ deaths} \times 10,000}{10,000 \times 14 \text{ days}} = 1.4 \text{ deaths/10,000 children <5 years/day CMR}$

Figure 25.1: Formula for and examples of crude mortality rate calculations (CMR)

Additionally, the population must be sampled for the occurrence of any diseases. Of particular priority is the determination of the presence of those diseases with the potential to become epidemic in the displaced population, e.g., measles and cholera. Efforts also must be made to determine the vaccination status of the population in order to determine which vaccines the population may need. Diseases commonly encountered in disasters and among displaced populations are listed in Table 25.4.

HEALTH CARE

In the emergency phase of complex health emergencies, particularly in resource-poor countries, four major infectious diseases are responsible for 60%–90% of the deaths: measles, diarrhea, acute respiratory infections, and malaria.⁹ The vulnerability to these infections is increased in persons suffering from malnutrition and vitamin deficiencies. Providing healthcare services to identify and treat these potential diseases is a priority throughout a disaster, but the immediate focus of healthcare relief activities must be on providing life-saving care and interventions to the affected population.

Patients with traumatic injuries may not have access to the required surgical facilities, and the relief agencies involved may not have the skills or supplies necessary for performing immediate surgical procedures. However, many of these patients can survive for days, or even weeks, while awaiting surgery if they receive proper medical and nursing care.⁹ Key skills for nurses working in

these settings include wound care, administration of intravenous fluids and medications (e.g., antibiotics), airway management, and supportive care.

Infectious Diseases

Measles

In refugee settings associated with disasters or complex emergencies, measles vaccinations, along with the administration of vitamin A, are two healthcare treatment priorities for the displaced population, beginning in the very early period after the event.¹¹ Vitamin A deficiency is a common occurrence in refugee populations who survive on food rations, particularly in children 1–5 years of age. Deficiencies of Vitamin A in children lead to xerophthalmia (blindness), a weakened immune system, and increase the risk for diarrhea, respiratory infections, and measles. The occurrence of blindness from Vitamin A deficiency is an ominous sign associated with a 50% likelihood of death within six months.¹³ Vitamin A deficiency also can cause increased maternal mortality. Vitamin A supplementation has been proven to reduce the mortality of children from 6 months to 5 years of age by 20–50%; the immune system, which is negatively impacted by malnutrition, is boosted by Vitamin A and, thus, protects children against diarrhea, acute respiratory infections, and measles.^{13–15}

Although the last 20 years have seen a decline in measles outbreaks since the widespread and rapid implementation of immunization vaccination programs, large-scale epidemics of the disease still may occur in refugee camps and other crowded situations, and are a leading cause of child mortality in these settings.¹⁰ Major measles outbreaks occurred among IDPs in Ethiopia and the Democratic Republic of the Congo in 2000 and 2001 as a result of delays in implementing vaccination programs.¹⁶ The incidence of severe cases of measles is higher in malnourished children than in non-malnourished children. Measles also rapidly depletes stores of Vitamin A, causing increased vulnerability to other diseases.¹² Aid workers must perform a rapid needs assessment to estimate the affected population's current coverage by measles vaccinations in children 9 months to 15 years of age. If this assessment reveals that <90% of the population has measles vaccination coverage, a mass immunization program must be initiated without awaiting the occurrence of a single case.¹² This program may be initiated through outreach teams, or by establishing screening centers at camp check-in points, or through a combination of these two methods.

Malaria

Malaria is endemic in certain regions and is common among populations displaced from an area of low malarial transmission rates to an area with high malarial transmission rates. Most of the one million deaths that occur annually from malaria worldwide occur in the sub-Saharan area of Africa.¹² The

movement of populations as well as interruptions in vector control programs during times of conflict can precipitate a change in the incidence of malaria. Conditions such as stagnant water, flooding, weather changes, and overcrowding in shelters, also contribute to its transmission. Deficiencies in essential micronutrients (Vitamin A, iron, zinc, and folate) that are present in many refugees contribute to the morbidity and mortality from malaria; pregnant women and young children are particularly susceptible to this disease. Prevention is directed toward preventing mosquito bites through the use of insecticide-treated netting and the spraying of shelters with insecticides. Mass prophylaxis typically is not recommended due to increasing resistance to some anti-malarial drugs.¹⁰ Surveillance must be implemented to include the rapid identification of all fever cases. The country's Ministry of Health will assist in making determinations regarding the initiation of anti-malarial agents and determining which treatment guidelines to utilize for which particular population (e.g., treatment only for high-risk groups, or for those with severe cases of malaria).

IN 1994, MORE THAN 1.8 million refugees from Rwanda fled to Burundi and Zaire to escape civil war and genocide. Information on an estimated 600,000 to 800,000 refugees living in camps during a one-month period revealed a high incidence of diarrhea (approximately 62,500 cases) of which 60% were due to cholera (watery diarrhea). Shortly thereafter, bloody diarrhea due to *Shigella* was confirmed in 15,543 cases. The majority of the 50,000 deaths were caused by diarrheal diseases.¹⁹

Diarrhea

Diarrhea from gastrointestinal infections (such as cholera, dysentery, and Norwalk-like viruses) often occurs in disaster shelters with overcrowding, inadequate water supply, and poor sanitation and hygiene. Dehydration poses the greatest risk with these infections, particularly among young children. Worldwide, approximately 1.8 million children die from diarrhea each year.¹⁰ In refugee camps, diarrhea has been responsible for >40% of the deaths, with 80% of these occurring in children <2 years of age.¹² Measures such as ensuring adequate potable water and personal hygiene (including accessibility to soap, and proper sanitation facilities and handling of excreta), as well as universal precautions in care centers are necessary to limit the incidence of diarrhea. Community education programs on essential hygiene techniques along with the distribution of soap also are beneficial. Oral rehydration therapy (ORT) units should be established at multiple sites throughout the camp to ensure proper surveillance of all dysentery cases and to deliver prompt rehydration therapy (oral rehydration salts) to the affected population. Intravenous fluids may be necessary for

those who are severely dehydrated. *Salmonella typhi*, a food-borne infection, may require treatment with antibiotics, such as chloramphenicol, or with some of the newer antibiotics, including the fluoroquinolones or cephalosporins. Shigellosis, dengue hemorrhagic fever, leptospirosis, and yellow fever also are potential threats in certain areas and situations.^{17,18}

Cholera, transmitted via contaminated food or water, is of particular concern because of its associated high mortality rate; without treatment, approximately 50% of patients with cholera die of dehydration. An outbreak of cholera among the 600,000 to 800,000 Rwandan refugees in camps in 1994 resulted in approximately 1,000 deaths per day.¹⁹ In addition to fluid and electrolyte rehydration and isolation in care centers, the administration of supplemental zinc has been shown to reduce both the severity and the duration of cholera.^{20,21}

ORAL REHYDRATION SALT SOLUTIONS

Safe, clean drinking water and adequate sanitation standards can help to prevent diarrhea-associated dehydration. But, for those who do develop this serious complication, ORT with prepared oral rehydration salt solutions (ORS) is a very effective, easy-to-use, cost-efficient treatment. In the absence of commercially prepared oral rehydration mixtures, salted soups, salted rice water, and/or salted drinks can be substituted. Homemade preparations of oral rehydration salt solutions must contain sugar as well as salt to aid the absorption of salt through the small intestines. According to the World Health Organization (WHO), an ideal homemade salt-sugar solution can be prepared with:²²

- 3 g of salt (approximately 1/2 teaspoon), and
- 18 g of sugar (3 1/2 teaspoons) in 1 liter of clean, boiled water.

Give the solution as follows until the diarrhea ceases:

- Children <2 years of age: 50–100 ml (a quarter to half a large cup) of fluid;
- Children aged 2 up to 10 years: 100–200 ml (a half to one large cup);
- Older children and adults: as much fluid as desired.

Ray Higginson

Acute Respiratory Infections (ARIs)

Acute respiratory infections (ARIs) — including pneumonia, bronchitis, bronchiolitis, pharyngitis, laryngitis, and sinusitis — are prevalent among both the pediatric and the elderly populations, as well as immuno-compromised and malnourished individuals.¹⁷ Overcrowding, inadequate shelter and blankets, adverse weather conditions, as well as compromised immune systems contribute to their occurrence and transmission. Most data on ARIs in victims of complex emergencies are related to associated mortality with little information on specific organisms.²³ However, in one study of ARIs in

refugees on the Thailand–Burmese border, the human metapneumovirus (hMPV) and the respiratory syncytial virus (RSV) predominated in young infants, while the influenza viruses were most common in older adults.²⁴ Prevention includes education regarding personal hygiene measures, increased ventilation within the shelter and in the treatment areas, head-to-toe arrangement of sleeping cots, and increased separation space (at least 1 meter) between individuals; ideally, symptomatic individuals are kept separated from those who are well. Vaccination for measles, diphtheria, and pertussis may reduce the incidence of ARIs by preventing diseases that increase the vulnerability to secondary infections. Vitamin A supplementation also provides protection from ARIs. Care measures consist of providing adequate hydration and nutrition along with fever control and protection from environmental elements. The complication of pneumonia should be treated with antibiotics to reduce associated mortality.

Tuberculosis

Tuberculosis (TB) is a major cause of death among refugee and displaced populations, and its incidence has increased dramatically in areas with a high prevalence of human immunodeficiency virus (HIV), such as sub-Saharan Africa and Asia.^{12,25} The risk of latent tuberculosis infection progressing to active tuberculosis increases up to 60–80% in HIV-infected individuals.²⁶ Factors contributing to the upsurge of tuberculosis include the relocation of large numbers of people into overcrowded shelters with inadequate food and water supplies and limited or absent healthcare services. The public health consequences of tuberculosis are enormous and require a concerted effort to address this disease. As complex emergencies may be prolonged, healthcare services must include programs aimed at identifying and treating cases of latent and active tuberculosis. Criteria have been established for implementing TB programs in emergency situations.²⁷ Key to effective management is the detection of individuals with the disease; this requires a high index of suspicion on the part of all healthcare workers, in particular nurses, who are likely to have the most contact with victims. Symptoms of a persistent cough for >3 weeks, especially if unresponsive to antibiotic treatment and accompanied by a loss of weight or hemoptysis, should prompt testing for tuberculosis.²⁸ Official guidelines for the treatment of tuberculosis in refugee and displaced populations have been developed by the WHO and should be followed.²⁷ Steps to reduce the transmission of tuberculosis include providing proper ventilation and light, practicing universal precautions, using facemasks (preferably high-efficiency particulate air masks, otherwise surgical masks), instructing patients regarding cough hygiene, and, of course, managing and preventing the occurrence of HIV.

HIV/AIDS

Along with the increase in tuberculosis is an increase in HIV/AIDS. The incidence of HIV/AIDS is particularly high in countries affected by complex emergencies; 5% of the adult population in sub-Saharan Africa are infected with HIV.²⁹ Numerous factors contribute to HIV transmission, not the least of which are sexual violence and coercive sex.^{30–32} A high incidence of sexually transmitted infections (STIs) has been reported in refugee situations, and there appears to be a strong association between (STIs) and the sexual transmission of HIV; STIs increase the shedding of the HIV in the genital tracts of infected men and women, which promotes transmission of the virus.^{33,34} Successful STI treatment reduces the spread of HIV and is one of the few known HIV preventions that has been used in emergency and post-emergency situations.^{35,36} When the situation becomes more stable, more comprehensive reproductive health services may be offered, including education, condom distribution and promotion, counseling services, and comprehensive care for people with HIV/AIDS.

The Minimal Initial Services Package (MISP) for reproductive health in crisis situations is a program developed by the Inter-agency Working Group on Reproductive Health in Refugee Situations. It details and prioritizes the actions needed to prevent and manage the consequences of sexual violence, reduce HIV transmission, prevent excess maternal and neonatal mortality and morbidity, and plan for comprehensive reproductive health services in the early days and weeks of an emergency. These activities include safe blood transfusions, access to condoms, materials for universal precautions, basic HIV/AIDS information and protection for women and children.³³ Prophylactic treatment with co-trimoxazole should be provided to: rape victims post-exposure; exposed victims, including staff; and newly diagnosed individuals, including babies born to HIV-positive mothers.³⁴

CONTROL MEASURES

There are many focused public health interventions that will help to control the spread of communicable diseases. Certain specific activities can decrease the disease risk factors of the population by ensuring that the community has its basic survival needs met as well as appropriate and essential medical care.

Water and Sanitation

In most disaster situations, health problems are caused by inadequate water consumption, poor hygiene due to insufficient water, and by the consumption of contaminated water.⁷ People can survive longer without food than they can without water. The acquisition of water-, sanitation-, and

DISEASE	PREVENTION	TREATMENT	COMMENTS
Acute respiratory infections	Education re. hygiene techniques; Increase separation space; Increase ventilation; Ensure adequate shelter & warmth	Fluids; Rest; Increase ventilation in care and feeding centers; watch for signs of pneumonia	Infants, elderly, immuno-compromised individuals are at greatest risk
cholera	Education re. hygiene techniques; Ensure safe water supply (chlorination if necessary); Safe disposal of feces; Encourage breast feeding of infants <6 months of age	Prompt rehydration (ORT or IV fluids); Supplemental zinc	Endemic in some countries; Increase incidence during rainy season; Early detection is key; Suspect in cases of watery diarrhea; Be suspicious of adult death from dehydration ⁷
Shigellosis (Shigella dysentery)	Education re. hygiene techniques; Separate toilets from bathing/drinking water sources; Safe disposal of feces	Prompt rehydration (ORT or IV fluids); Antibiotics according to sensitivity	Endemic in tropical and temperate climates; Suspect in cases of bloody diarrhea
Measles	Vaccination; Vitamin A supplementation	Isolation in well-ventilated area; Supportive treatment	Early emergency vaccination program if <90% of population is vaccinated or if never exposed to measles
Malaria	Insecticide-treated bed nets; Protective clothing; Periodic insecticide spraying of environment; Insecticide-treated beds; Drain standing water around taps	Chloroquine; Artemesinin combination therapies	Endemic in tropical climates; Children and pregnant women most vulnerable; Presumptive treatment should be considered
HIV/AIDS/STD	STD education programs with free condom supply; Protection and security programs for women and children; Universal precautions; Single-use syringes; Testing of all blood donors	Treat opportunistic infections; Ensure adequate nutrition; Treat using WHO guidelines ^{33,34}	Women/girls are most vulnerable and require protection; Monitor for TB
Meningococcal meningitis	Vaccination with vaccine appropriate for laboratory-confirmed strain of meningococcal meningitis	Antibiotics (chloramphenicol, penicillin, ampicillin); Supportive treatment	Peaks in winter; Seasonal risk of epidemics in parts of West Africa; Maintain high level of suspicion
Tuberculosis	Prompt case finding and treatment of individuals with tuberculosis	Treat using WHO and national treatment norms ²⁶	An opportunistic infection of HIV/AIDS and malnutrition
Scurvy	Breast feeding of infants; Fresh fruits and vegetables; Vitamin C supplements; Vitamin C-enriched flour	Ascorbic acid tablets	Pregnant women at increased risk; Suspect in persons with lower limb pain, temporary paralysis, and hemorrhage ¹³

Table 25.4: Commonly occurring diseases in disasters and displaced populations (ORT = oral replacement therapy, IV = intravenous, STD = sexually transmitted diseases, WHO = World Health Organization, TB = tuberculosis)

hygiene-related diseases by the population are controllable and preventable by:

- Providing and maintaining sufficient quantities of water (Table 26.5);
- Ensuring that the water supply is easily accessible to the population;
- Protecting the water supply from pollution/contamination;
- Assessing the water for pH, residual chlorine, and fecal pollution (Table 6);
- Ensuring the availability of adequate and clean toilets (maximum 20 persons/toilet);
- Implementing a waste disposal process; and
- Providing accessible hand-washing facilities and supplies, including 250 grams of soap/person/month.

While drinking and cooking water must be of high quality, water used for personal hygiene may be of lower quality. When necessary, water may be treated by storage, sand filtration, chemical disinfection with chlorine, or boiling.

Individual Needs	15 liters/day total
Basic cooking needs	3–6 liters/day
Basic hygiene needs	Approximately 6 liters/day
Survival needs (drinking and food)	3–4 liters/day
Feeding Centers Needs	20–30 liters/patient/day
Healthcare Centers Needs	40–60 liters/inpatient/day

Table 25.5: Basic water survival needs¹¹

Fecal coliforms/100 milliliters	Risk
0–10	Reasonable quality
11–100	Polluted
101–1,000	Very polluted
>1,000	Grossly polluted

Table 25.6: Fecal determinants of water quality and safety¹¹

Food and Nutrition

Sustained access to food and the maintenance of adequate nutrition are critical determinants of people's survival. Food supply often is interrupted during the emergency phase of complex emergencies. General food aid programs usually are targeted for specific populations, and are organized only for limited periods of time immediately following an event or a population displacement.⁹ Even with the implementation of food aid programs, inadequate distributions result-

ing in food shortages have been reported. Getting food aid to those for whom it is intended is challenging. This may be due to damaged or destroyed food stores or deliveries, or food being stolen, sold, or diverted.³⁷ Warring parties may abscond with and withhold food supplies in order to obtain their own political or military objectives. Women are most likely to face the brunt of food shortages, particularly in male-dominated cultures; women also often give their food rations to their hungry children. This has led to the practice of issuing household food rations to the female member of the household who is most likely to ensure that her children receive their allotted rations.



Figure 25.2.: Middle-upper arm measurement in a severely malnourished child

Displaced persons, particularly children between 6 months and 5 years of age, are susceptible to protein-energy malnutrition (PEM) and micronutrient deficiencies. The prevalence of malnutrition in children <5 years of age provides a reliable measure of the nutritional status of the entire population.¹⁰ This information can be acquired through cluster sampling. Generally, acute malnutrition in young children is determined through the use of weight-for-height kilograms/centimeters measurements (Table 25.7) or mid-upper arm circumference (MUAC) measurements (Table 25.8 and Figure 25.2). Weight-for-height measurements are compared to median measurements of comparable reference children (obtained from available reference tables) and expressed as a percentage of the reference value (Table 25.7).

Although the upper arm measurement is easier and quicker to obtain, its predictive value of severe malnutrition (weight-for-height <75%) is poor.³⁸ Thus, the weight-for-height measurement remains the gold standard for assessment of acute malnutrition in children. Figures 25.3 and 25.4 depict simple methods of obtaining height and weight measurements in children when limited resources are available.

In adults, the Body Mass Index (BMI), which is determined by dividing the weight (in kilograms) by the height (in meters²) — often is used to assess

NUTRITIONAL STATUS	WEIGHT-FOR-HEIGHT PERCENTAGE
Normal	≥80%
Moderate malnutrition	70–79%
Severe malnutrition	<70%, or presence of edema (Figure 25.5)

Table 25.7: Nutritional status of children based on median weight-for-height percentage measurements



Figure 25.3: Measuring the length of a malnourished child



Figure 25.4: Preparing a child for weight measurement using a chair sling

nutritional status and needs. However, this measurement does not take into consideration adult body size, shape, and composition, which vary among different populations. In addition, its use in assessing acute states of malnutrition in adults has been questioned, particularly when accompanied by edema.³⁹ Severely malnourished adults may not be able to stand up for height or weight measurements. Although MUAC measurements are recommended only for use in assessing the nutritional status of children from one to five years of age, these measurements frequently are used in adults as well. The MUAC measurement is less affected by edema and by height than the BMI, and is easier and quicker to measure. Table 25.9 lists proposed MUAC



Figure 25.5: Evidence of total body edema in a severely malnourished child

NUTRITIONAL STATUS	ARM CIRCUMFERENCE (CENTIMETERS)
Normal	≥12.5
Moderate malnutrition	11.0–12.5
Severe malnutrition	<11.0

Table 25.8: Nutritional status of children based on mid-upper arm circumference

cut-off values to determine malnutrition in adults;⁴⁰ further research is necessary to confirm the validity of these measurements. Clinical signs, such as dehydration, edema, and the inability to stand are useful clinical assessment indicators of nutrition when combined with other assessments, such as the MUAC measurement.³⁹

Adequate nutritional needs of the affected population can be provided by:⁹

- Ensuring a ration of at least 2,100 kilocalories (including 60 grams of protein)/person/day either through food aid or through supplementation of the population's existing food stores;
- Ensuring an adequate fuel supply to households for cooking needs;
- Implementing a targeted feeding program for special needs groups; and
- Ensuring proper food supply chain and distribution.

NUTRITIONAL STATUS	MID-UPPER ARM CIRCUMFERENCE
Normal	>185 millimeters
Moderate malnutrition	160–185 millimeters
Severe malnutrition	<160 millimeters

Table 25.9: Nutritional status of adults based on mid-upper arm circumference⁴⁰

Nutritional programs typically consist of general feeding programs providing rations to the overall population and selective, supplementary, feeding programs aimed at specific individuals or groups of individuals. According to Sphere standards, general feeding programs must provide 2,100 kilocalories/person/day.⁹ Supplements should provide an additional 400 kilocalories and 15 gram of protein per day to targeted groups, particularly malnourished children, women who are in the last trimester of pregnancy and the first 12 months of lactation, and other vulnerable populations, such as the sick and elderly. Supplemental food programs also are targeted to children with evidence of moderate malnutrition (70–79% weight-for-height or MUAC measurement of 11.0 to 12.5 centimeters). Various ready-to-use food supplements have been developed that provide the necessary nutritional and micronutrients required. In a study of children in rural Malawi, greater weight gain and recovery was observed in children who received the ready-to-use therapeutic food (RUTF) supplements compared to those who received the traditional corn/soy-blend food fortified with micronutrients.⁴¹ The goal of supplemental feeding is to achieve an 80% weight-to-height measurement in each child; supplemental feeding may be discontinued when this goal is achieved.

Therapeutic feeding programs are targeted to children with evidence of

GRADE	EXTENT OF EDEMA
0	Absent
1	Minimal on foot or ankle; not obvious
2	Obvious on foot or ankle
3	Demonstrable up to knee
4	Demonstrable up to inguinal ligament
5	Total body edema (anasarca)

Table 25.10: Grading of famine edema in adults according to the Beattie classification⁴²

severe malnutrition such as <70% weight-for-height, MUAC <110 cm, or edema. Evidence of famine-related edema in either children or adults is an indicator of severe malnutrition requiring therapeutic intervention (Figure 25.5). However, the presence of edema in adults may be due to other causes that must be considered and ruled out. In both children and adults, famine edema should be determined by applying firm pressure over a bony prominence for approximately 3 seconds and assessing the level of indentation that remains after the pressure is removed.³⁸ The severity of the edema is then graded as described by Beattie and outlined in Table 25.10.⁴² Edema graded as >3 prompts therapeutic nutritional intervention.³⁹

The management and nutritional care of severely malnourished children may be carried out in hospitals within the shelter, if available, or at special feeding centers located within the camp. Depending on the severity of the child's condition, he/she may remain in the center 24 hours/day for treatment and care, or spend only the day in the center, and remain with his/her family at night.

In the acute phases of a disaster, emergency care, including nutritional care, must be triaged according to the number of victims and the available resources. In terms of nutritional care, this means prioritizing the food supply. In such cases, it generally is accepted that the first priority is to provide general rations sufficient to keep people alive. The second priority is to prevent the further deterioration of moderately malnourished children. And, the final priority is to provide the nutritional needs of the severely malnourished.⁴³ This is in keeping with the disaster triage goal of ensuring that the greatest number of casualties survive.⁴⁴

Shelter

The “sheltering process” includes “essential services such as food, water, sanitation, health, education, as well as projects to restore people’s dignity.”⁴⁵ Sheltering is a basic human right. A shelter refers to any habitable structure that provides protection from the elements. Shelters are meant to be temporary: to be used for the shortest time possible. Most shelters consist of tents, or tent materials that provide protection from sun and rain, but often are not able to withstand the heavy weight of snow. Local materials (e.g., leaves, clay, and grasses) are other shelter options.

Many sheltering camps or settlements are set up by displaced populations prior to the arrival of any aid organizations. Poor planning of these self-created settlements or camps can lead to health risks due to overcrowding, poor sanitation, and poor hygiene. This environment can increase the potential for a disease outbreak or an epidemic. There also is considerable risk to the displaced population from exposure to natural elements (e.g., rain, cold, heat, or snow) because of limited sheltering or poorly constructed shelters.

Small campsites are preferable to large sites because of the inherent difficulties of managing thousands of inhabitants; however, typically, the refugees have already established the site before the arrival of any aid agencies. Thus, proper organization of the site becomes an immediate action to be undertaken by the responding agencies. Proposed shelter construction and layouts are provided by numerous organizations. Some general guidelines for campsite planning and management include:

- Provide easy access to water, food, health care, and other services sites;
- Plan for sanitation areas of at least one latrine/20 persons;
- Provide blankets, insulation, and heaters in cold climates;
- Provide for the ventilation of shelters in humid climates;
- Provide easy access to the campsite with security at access points, and establish an emergency evacuation route;
- Plan for a minimum of 45 m² surface space/person;⁹ and
- Plan for at least 3.5 m² covered living space per person (except in immediate emergency situations).

VECTOR-BORNE DISEASES

Vector-borne diseases (VBD) are a major public health concern in developing countries. In India, dengue fever is a particularly problematic VBD and requires specific management. Primary prevention of dengue fever consists of two methods of mosquito control: (1) larval control; and (2) adult mosquito control.

The *Aedes albopictus* mosquito, the vector for dengue, breeds in man-made waste, such as old cooking utensils, used rubber tires, plastic bottles, and flowerpots. Proper waste disposal, regular surface cleaning, elimination of stagnant water, and appropriate water storage facilities can help prevent mosquito reproduction and the spread of dengue fever.

Ray Higginson

Vector Control

Vectors (e.g., rats, mosquitoes and other insects) are capable of spreading disease and must be controlled to limit their threat to the health of the displaced population. Control measures include those measures discussed relating to shelter site location,

water and sanitation, and food and nutrition. Additional measures may include:

- Eliminating any sites of standing water (e.g., around water taps) or unused ponds;
- Using insecticides and insecticide-coated netting and bedding;
- Setting traps for tsetse flies; and
- Protecting and securing food storage areas.

The cultural and behavioral practices of the population must be considered in implementing any control interventions.

HUMAN RIGHTS

It is imperative that all forms of humanitarian assistance be provided without any discrimination and in full recognition of the human dignity and rights of the recipients. All persons involved in providing humanitarian assistance must be cognizant of the UN Universal Declaration of Human Rights, and the 30 articles outlining how people are to be treated by their governments and society.⁴⁶ In terms of health, minimum human rights include access to essential medical services and sanitation. Special attention must be given to providing assistance and protection to children, young girls and women, the elderly, persons with disabilities or HIV/AIDS, and members of ethnic or religious minority groups. Victims must be provided with information in a language that they understand and in a manner that is respectful of them and their culture.

ADDITIONAL CHALLENGES

There are several major additional challenges for healthcare workers responding to disasters. These include health and safety concerns, logistical problems, communication (including language and cultural differences), the “who is really in charge” syndrome, and the need to avoid illness, especially gastrointestinal ailments, tuberculosis, and HIV. Additionally, the basic humanitarian principles of humanity, impartiality, and neutrality must be maintained.⁴⁷

Obtaining clean, dry bedding, adequate dry clothing, and personal hygiene products are necessary for disease prevention. Working in extreme heat or cold contributes to the challenges of maintaining one’s own health and of finding adequate personal shelter. Exposure to communicable diseases within the population threatens aid workers’ health; all providers should receive the same protective inoculations given to the affected population. Care providers must be conscientious in using universal precautions and taking measures to ensure their own state of good health, i.e., getting sufficient rest and nutrition. The presence of orphaned children, families without an adult male, and female aid workers, also create an increased safety risk. Most individuals who work in the healthcare sector of disaster relief develop a passion

and commitment, as well as a personal sense of satisfaction, that enable them to work in spite of the challenging circumstances.

CONCLUSION

Reducing morbidity and mortality are of highest priority in providing health care to populations displaced due to a disaster. The swiftness and effectiveness of the public health measures initiated by responding agencies are key determinants in the survival of a large portion of the affected community. The initial needs assessment is crucial in determining the response objectives and guiding the selection of appropriate interventions and prioritizing those needing urgent implementation.

Addressing the population's basic needs will assist in the improvement of health and the reduction of disease transmission among the affected community. These needs include the provision of food and water, proper hygiene, and sanitation. In addition to these challenges in resource-poor countries, the environment brings further challenges in the form of overcrowded and chaotic conditions, extremes in weather, and concerns of personal safety from wars or political tensions. However, overcoming these obstacles and challenges is critical for the effective delivery of care to a population in extreme need. The nurse's role is paramount in the resolution of these difficulties and in the ultimate survival of the displaced population.

SOUTHERN SUDAN, 1998

Years of drought and ongoing civil conflict resulted in a famine situation, the deaths of nearly 80,000 people, and the migration of tens of thousands of people in search of food and humanitarian aid. Despite the institution of therapeutic feeding programs for malnourished children, the crude mortality rate remained high (20 deaths/10,000 people/day) for a number of months. Factors that contributed to this high mortality rate included: a high prevalence of severe malnutrition; poor therapeutic feeding management of severely malnourished children; a high prevalence of severe undernutrition in adolescents and adults who were not targeted for therapeutic feeding; and a major outbreak of shigella dysentery. Lessons learned from this crisis include: (1) undernourished adolescents and adults must be included in therapeutic feeding programs; and (2) the close relationship between malnutrition and communicable diseases requires that feeding programs be accompanied by public health interventions and education.⁴⁸

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CHAPTER 26

DISASTER MENTAL HEALTH

Margaret Grigg and Frances Hughes

EXPOSURE TO EXTREME STRESSORS, such as those that occur in a disaster, results in a wide range of social and psychological impacts and contributes to an increase in the prevalence of mental disorders. While an estimated 10% of the general population have a mild-to-moderate mental disorder, the prevalence increases by an estimated 5–10% following a disaster; similarly, the prevalence of severe mental health problems, such as psychosis, is likely to increase from the usual 2–3% to 3–4% following a disaster.¹ Although the majority of people will recover from psychological distress without intervention,² disaster nurses need to understand the principles of disaster mental health and provide care for individuals with severe mental health problems who require effective treatments to promote their recovery.

OBJECTIVES:

- Identify normal emotional and behavioral responses to disasters;
- Describe the primary prevention strategies to reduce the mental health impact of disaster on individuals, families, and communities;
- Identify common mental health problems associated with a disaster; and
- Understand the mental health needs of disaster workers.

MENTAL HEALTH

Mental health disorders are clinically significant conditions characterized by alterations in thinking, mood (emotions), or behavior that are associated with personal distress and/or impaired functioning, and are classified by the International Statistical Classification of Diseases and Related Health Problems Version 10 (ICD-10).^{3,4}

A “mental health problem” is a broader term that includes distress associated with alterations in thinking, mood, or behavior, but does not necessarily meet the

criteria for a mental disorder according to the ICD-10. For example, following the death of a loved one, a person may experience lowered mood and sleeplessness. While these symptoms are personally distressing, they may not be severe enough or prolonged enough to meet the ICD-10 definitional requirements for depression.

Mental health is influenced by socioeconomic and environmental factors, such as poverty, discrimination, exposure to violence, quality of housing, and access to a productive occupation.⁵ Disasters disrupt the lives of individuals, their families, and the social structures in which they live. Families may be separated, schools and workplaces may be closed, and religious obligations may become difficult to fulfill. This disruption contributes to the emotional distress of individuals and their families, and increases the risk that a mental health problem will develop. The greater the exposure to a traumatic event that the person experiences, the higher the likelihood that their mental health will be affected adversely.^{2,6} A sentinel study of the relationship between disaster exposure and post-traumatic stress disorder (PTSD) following a catastrophic event in a factory demonstrated a strong correlation between injuries, proximity to the epicenter of the event, and the prevalence and duration of symptoms of PTSD.⁷

CORE RESPONSE PRINCIPLES

The mental health responses in a disaster should be based on the five core principles of: (1) human rights promotion and protection; (2) participation; (3) multilayered support; (4) do no harm; and (5) integration:¹

- *Human rights promotion and protection* — There is a strong relationship between human rights and mental health; violations of human rights negatively impact on individual well-being, while allowing people to assert their rights promotes mental health;
- *Participation* — People from communities affected by disasters should be encouraged to become involved in the disaster response. The early involvement of affected people assists in establishing a dialogue with affected communities and assists them in taking control of their lives;
- *Multilayered support* — No single component of the health or welfare sector is able to meet all of the mental health needs of a community. An effective mental health response during or after a disaster requires cooperation across a range of sectors;
- *Do no harm* — It is essential that all mental health interventions do no harm. Single-session psychological debriefing to reduce traumatic stress and/or the widespread use of medications, such as benzodiazepines to reduce anxiety, are at best ineffective,

and, in some cases, cause harm. Effective mental health interventions require a system-wide public health approach that considers the existing mental health services and the needs of the entire population;⁸ and

- *Integration* — During a disaster, it is essential that mental health care be integrated into general health care. The inclusion of mental health care into primary health care can prevent duplication and fragmentation of efforts.

PREPAREDNESS

Preparation is crucial to ensuring an effective mental health response following a disaster-producing event. Preparation should include the development of strategies for rapid action, building the capacity of disaster healthcare workers to respond effectively, and taking actions to avert or reduce the impact of the disaster. When communities are well-prepared, they are better able to respond to and recover from an event.^{9,10} Planning focuses attention on the importance of disaster mental health plans and enhances relationships between community organizations as well as governmental and non-governmental agencies.¹¹

The provision of mental health services during a disaster may be different from the provision of such services during non-disaster times. For example, during a disaster, social structures may be disrupted, a large number of people may require or request treatment, and health services are likely to be strained. Mental healthcare service, therefore, needs to be flexible, innovative, mobile, and extensive, while at the same time retaining the ability of healthcare providers to prioritize care.

The healthcare workforce, in general, and nurses, in particular, are vital to any large-scale demand for care. As part of the healthcare team, nurses are in a unique position to provide mental health assistance and promote recovery from the effects of a disaster. However, appropriate planning requires knowledge of the number and skills of available nurses, as well as strategies to ensure that they can be deployed effectively in the event of an emergency. Similarly, information is needed about the affected community's existing mental health system, such as the location and number of patients in psychiatric hospitals, the number of patients being treated within the community, and the availability of professional mental health personnel. Particular attention should be given to developing contingency plans within healthcare institutions; patients in psychiatric hospitals are extremely vulnerable, and the disruptions associated with disasters may expose patients to human rights abuses. The disaster preparedness plan also should define procedures for providing information to relatives and offering them practical assistance and support.¹²

PHYSICAL	BEHAVIORAL
Faintness and dizziness Hot or cold sensations Tightness in throat and chest Agitation, nervousness, hyperarousal Fatigue and exhaustion Gastrointestinal distress and nausea Appetite decrease or increase Headaches Exacerbation of pre-existing conditions	Sleep disturbances and nightmares Jumpiness — easily startled Hypervigilance — scanning for danger Crying and tearfulness Conflicts with family and coworkers Avoidance of reminders of trauma Inability to express feelings Isolation or withdrawal from others Increased use of alcohol or drugs
EMOTIONAL	COGNITIVE
Shock, disbelief Anxiety, fear, worry about safety Numbness Sadness, grief Longing and pining for deceased Helplessness Powerlessness and vulnerability Disassociation (disconnected, dream-like) Anger, rage, desire for revenge Irritability, short temper Hopelessness and despair Blame of self and others Survivor guilt Unpredictable mood swings Re-experiencing pain associated with previous trauma	Confusion and disorientation Poor concentration and memory problems Impaired thinking and decision-making Complete or partial amnesia Repeated flashbacks, intrusive thoughts and images Obsessive self-criticism and self-doubts Preoccupation with protecting loved ones Questioning of spiritual or religious beliefs

US Department of Health and Human Services 2004⁵²Table 26.1: Potential individual survivor responses in emergency and disaster situations ⁵²

NORMAL RESPONSES TO STRESS

Normal reactions to the trauma associated with disasters can be clustered into four categories: (1) physical; (2) behavioral; (3) emotional; and (4) cognitive responses. These are summarized in Table 26.1. Individual responses are varied and reflect the person's developmental level, usual coping styles, gender, and cultural background.

For most people, fear, anxiety, re-experiencing the trauma, urges to avoid situations associated with the trauma, and hyperarousal symptoms, if present, decrease gradually over time.¹³ While these responses primarily relate to events

that already have happened (i.e., the recent trauma), many people in disaster situations also may have extreme fear of the future, such as the ability to provide for their family, having the resources to pay school fees, etc. These responses can last for many months, often fluctuating in severity. Recovery rarely is linear; survivors frequently experience relapses of symptoms during periods of stress.

PREVENTING MENTAL HEALTH PROBLEMS FOLLOWING A DISASTER

Many individuals who have experienced a catastrophic event initially will display some signs of psychological distress. This is normal and it is neither appropriate nor effective to implement formal intervention strategies during the immediate post-impact phase of a disaster. Strategies to promote mental health following the disaster should focus on helping people meet their basic needs (i.e., food, shelter, and safety) and establishing and disseminating a reliable flow of credible information; this is essential to reducing the distress of survivors. Information should include details about the emergency, efforts that are being undertaken to ensure the physical safety of the population, and the location of family and friends. Survivors also need to be advised of the aid agencies involved, relief efforts, and where these agencies are located. Additionally, survivors should be provided information about the normal stress reactions they are likely to experience (Table 26.1). Although these responses are normal reactions, they may seem far from “normal” to the individual who experiences them, and they need to be assured that such reactions are normal responses to abnormal events, and that they will resolve over time. It also is important to acknowledge the victims’ experience and provide encouraging support of their strengths and managing skills.

Survivors also need to be protected from further harm and further exposure to harmful stimuli. If possible, shelters or safe havens should be provided to keep families and communities together; the less people are exposed to further traumatic stimuli, the better off they will be. Where possible, efforts should be made to protect the privacy of families via screens or shelters. Media exposure is common after an emergency; this can be both reassuring to victims and harmful, particularly to children, and, therefore, must be monitored carefully.²

In addition to the physical loss and trauma of emergencies, families often become separated at a time when they need each other most. Tracing services should be established and an information center set up to assist families to locate each other and to send and receive communications. It is particularly important that children be reunited with their parents as soon as possible.

Where possible, survivors should be involved in purposeful common activities (such as organizing and constructing shelters, organizing family tracing, distributing food, and teaching children) in order to provide some sense of control

1.	People have access to ongoing, reliable flow of credible information on the disaster and associated relief efforts.
2.	Normal cultural and religious events are maintained or re-established (including grieving rituals conducted by relevant spiritual and religious practitioners). People are able to conduct funeral ceremonies.
3.	As soon as resources permit, children and adolescents have access to formal or informal schooling and to normal recreational activities.
4.	Adults and adolescents are able to participate in concrete, purposeful, common interest activities, such as emergency relief activities.
5.	Isolated persons, (such as separated or orphaned children, child combatants, widows and widowers, older people, or others without their families) have access to activities that facilitate inclusion in social networks.
6.	When necessary, a tracing service is established to reunite people and families.
7.	Where people are displaced, shelter is organized with the aim of keeping family members and communities together.
8.	The community is consulted regarding decisions on where to locate religious places, schools, water points, and sanitation facilities. The design of settlements for displaced people includes recreational and cultural space.

Sphere Project 2004¹⁸, p.291.

Table 26.2: Sphere Standard for Mental and Social Aspects of Health in Disasters: Key Social Intervention Indicators¹⁸

1.	Individuals experiencing acute mental distress after exposure to traumatic stressors have access to psychological first aid at health service facilities and in the community.
2.	Care for urgent psychiatric complaints is available through the primary health care system. Essential psychiatric medications, consistent with the essential drug list, are available at primary care facilities.
3.	Individuals with pre-existing psychiatric disorders continue to receive relevant treatment, and harmful, sudden discontinuation of medications is avoided. Basic needs of patients in custodial psychiatric hospitals are addressed.
4.	If the disaster becomes protracted, plans are initiated to provide a more comprehensive range of community-based psychological interventions for the post-disaster phase.

Sphere Project 2004¹⁸, p.291

Table 26.3: Sphere Standard for Mental and Social Aspects of Health in Disasters: Psychological and Psychiatric Intervention Indicators¹⁸

over their situation and opportunities for meaningful activity. Recreational activities for children should be encouraged and, as soon as feasible, schools should be re-established. Community officials should be consulted as to the location of religious places, schools, and water supplies. Space should be provided in camps for religious, recreational, and cultural activities. Maintaining or re-establishing community rituals provides context and meaning to psychological healing.¹⁴

Mass burials prevent survivors from burying their family and friends according to local customs and beliefs and can make individual identification impossible. Survivors have a strong psychological need to identify loved ones and grieve for them in customary ways.¹⁵ For example, in a personal account of the Rawandan genocide, Bagilashya describes the trauma of learning of his son's death 12 months after he disappeared, and his journey in dealing with his trauma and grief using a framework consistent with Rawandan culture.¹⁶ Humanitarian care and treatment of the dead can have an important effect on the recovery of survivors and of the entire community.¹⁷

The *Sphere Handbook*¹⁸ describes 12 minimum standards in disaster responses to address the mental and social aspects of health. These standards are described in Tables 26.2 and 26.3. A recent review of the literature has provided support for the relevance and effectiveness of these standards.¹⁴

MENTAL HEALTH PROBLEMS ASSOCIATED WITH DISASTERS

Potential mental health problems affecting adults after a disaster-producing event include depression, post-trauma symptoms, bereavement, alcohol and drug problems, and suicide. Mental health problems in children and adolescents, as well as the elderly, also are common after an emergency, although they may present differently.

PEOPLE AFFECTED BY THE TSUNAMI on 26 December 2004 were subject to extreme stressors and at risk of serious mental health problems and disorders both immediately and in the long term. An advanced mental health team conducted an assessment of victims in Aceh, Indonesia, during the first week of January 2005; survivors demonstrated one or more of the following symptoms: fear, panic, helplessness, emotional numbing, disbelief, confusion, nightmares, flashbacks, hyperactivity, fear of returning to the original place, fear of water, fear of being inside a building, restlessness, and/or fatigue.¹⁹

Depression

While many people may describe feeling low, sad, or even miserable during or after a disaster, clinical or major depression can be distinguished from minor forms by the quality and severity of the symptoms and the associated

decline in social and occupational functioning.²⁰ Emotional and behavioral symptoms of depression may include sadness, misery, loss of interest in usual activities, feelings of guilt, tiredness, fatigue, aches and pains, hopelessness, difficulty making decisions, low self-esteem, suicidal thoughts, disturbed sleep, and changes in appetite. In severe cases, the victim might experience hallucinations or delusions.

Treatment for depression combines biological, psychological, and social interventions. Disaster nurses and other healthcare professionals play an important role in recognizing depression among victims, providing general support and, if necessary, referring the person to a mental health professional. Suggested interventions include:

- Provide an explanation of what is happening and reassurance that they will recover;
- Be non-judgmental and demonstrate empathy — telling people to ‘snap out of it’ usually makes the symptoms worse;
- Encourage the individual to discuss his/her feelings with a family member or trusted friend;
- Assist the person to deal with his/her problems by using a problem-solving counselling approach that focuses on teaching him/her skills to solve his/her own problems. That is, rather than telling people how to solve their problems, help the persons clarify what the problem is, explore the options, evaluate each option, and implement their preferred choice of action;
- Encourage physical health by providing strategies to improve sleep and ensure proper nutrition and exercise;
- Discourage the use of alcohol or non-prescription drugs; and
- If the victim’s depression worsens or does not improve, refer him or her to a mental health worker or more experienced mental healthcare professional.

Post-trauma symptoms

While many people exhibit emotional symptoms following a disaster-producing event, a small number develop a serious problem that affects their ability to cope or that disrupts their relationships with family or friends. Acute stress disorder (ASD) is a transient anxiety response to trauma and begins during or shortly after the traumatic event. Symptoms of an ASD include an initial dazed state followed by agitation, emotional numbing, acute anxiety, amnesia, intrusive memories, and a hyperarousal state.²¹ The disturbance typically lasts between two days and four weeks, and for the majority of people, the symptoms resolve with no intervention. However, for a small number of people,

symptoms persist and are associated with significant impairment and distress resulting in the development of the PTSD.

The core symptoms of PTSD include: (1) re-experiencing the traumatic event through dreams or flashbacks; (2) avoidance of situations, activities, or stimuli that remind the person of the traumatic event; (3) loss of interest in usual activities; (4) restrictions in the normal range of emotions; and (5) a hyperarousal state such as insomnia, hypervigilance, poor concentration, or irritability. The symptoms of PTSD may present following an ASD or symptoms may be delayed in some victims who display no apparent stress symptoms at the time of the disaster. Symptoms of PTSD can persist for many years; co-morbid depression and other anxiety symptoms are common.²¹ Characteristically, PTSD has a later post-event onset than does ASD, with symptoms that persist for at least one month.²²

Interventions that can assist the person with PTSD include:²²

- Reassuring the person that their reactions are normal, and can be treated, and that they are not “going crazy”;
- Encouraging the person to talk about the event; for example, asking the person about when the event started, what he/she was doing, who else was present, etc.;
- Encouraging the person to talk with others. Victims may be fearful of talking with others because they don’t want others to know how they are feeling or because talking to others causes flashbacks. Explain to the person that it is important that he/she does talk about it;
- Establishing groups for people with post-trauma symptoms to encourage people to talk with others, as well as to promote friendships and help people understand that they are not alone;
- Encouraging the person to confront uncomfortable situations. For example, it may be helpful to revisit the site where the trauma occurred. If necessary, go with the person or encourage him/her to be accompanied by someone they trust;
- Helping the person solve other problems in his/her life, if post-trauma symptoms are worsened by other stressors (e.g., assisting the person in obtaining adequate housing);
- Helping the person deal with uncomfortable symptoms. For example, educating the person about how to improve his/her sleep. Alternatively, sedatives could be used, but only for short periods;
- Identifying if the person has any other mental health problem (for example depression), and providing appropriate treatment; and

- Referring the person to a mental health specialist or a more experienced health worker if symptoms do not resolve or the person is very distressed.

Post-trauma symptoms in children reflect the child's cognitive and developmental level as well as their perception of trauma. More serious symptoms in children are associated with greater levels of exposure to the disaster, closer proximity to the disaster site, a history of previous trauma, female gender, and poor parental coping response.²³ Table 26.4 provides a summary of common reactions in children at the different developmental ages.

FOLLOWING THE TERRORIST ATTACKS in the United States on 11

September 2001, a longitudinal study was conducted that evaluated the risk factors associated with prolonged post-traumatic stress.²⁴ The study involved a random sample of the US population living outside of New York City. Two months after the attacks, 17% of the 933 subjects reported symptoms of PTSD; a total of 5.8% of the subjects continued to report symptoms six months later. This study demonstrates that the psychological effects are widespread and are not limited to those individuals directly involved in the crisis situation.

The study also assessed the mental health history of the population sample prior to the events. Those who had a history of anxiety or depressive disorders or other mental health problems were more likely to have persistent problems following the attacks. Behavioral disengagement (such as denial, giving up, and self-destructiveness) were associated with the later development of symptoms of PTSD. This study emphasizes the need to recognize that individuals may experience trauma-related symptoms following an emergency or disaster, even if they are not directly exposed to the situation. Early signs of giving up are warning signals for healthcare workers and are factors that are highly predictive of subsequent distress.

Treatment of individuals with PTSD symptoms typically involves psychotherapy, usually utilizing a cognitive behavioral approach that combines anxiety management and cognitive restructuring to challenge thoughts and behavioral strategies. Cognitive behavioral therapy (CBT) is a psychological therapy rooted in learning theory. Specialized CBT techniques for disaster responses include stress inoculation therapy (SIT) to assist people in understanding and managing their trauma-related fears and decreasing avoidance behaviors. Other techniques include exposing the person to the trauma in a safe and controlled context to help the survivor manage anxiety, and teaching the person to manage the emotional symptoms of the trauma, such as anxiety and anger. In severe cases, medication may be combined with the psychotherapy.²⁵ Cognitive behavioral therapy requires specialist training and should be provided by mental health professionals.

AGE GROUP	BEHAVIORAL SYMPTOMS	PHYSICAL SYMPTOMS	EMOTIONAL SYMPTOMS
Pre-school (0–5 years of age)	Bed wetting Thumb sucking Fear of the dark Refusal to sleep alone Increased crying Clinginess Aimless moving	Loss of appetite Stomach aches Nausea Sleep disturbances, such as nightmares Speech difficulties	Anxiety Fear Irritability Angry outbursts Sadness Withdrawal
Childhood (6–11 years of age)	Decline in school performance Aggression Hyperactivity Behaving like a much younger child Increased competitiveness with siblings for parental attention	Change in appetite Headaches Stomach aches Sleep disturbances such as nightmares	School avoidance Withdrawal from friends Angry outbursts Obsessive preoccupation with disaster safety
Adolescence (12–18 years of age)	Decline in academic performance Rebellion at home or school Decline in previous responsible behavior Agitation or decrease in energy level Apathy Delinquent behavior Social withdrawal Drug, alcohol, tobacco use or abuse	Appetite changes Headaches Gastrointestinal problems Skin eruptions Vague complaints of aches Sleep disorders Nightmares	Loss of interest in peer activities Sadness or depression Resistance to authority Feelings of inadequacy or hopelessness

US Department of Health and Human Services 2004⁵³

Table 26.4: Common responses to disasters among children and adolescents (Adapted from US Department of Health and Human Resources⁵³)

Historically, psychological debriefing has been the method most widely used to mitigate acute emotional distress and prevent the emergence of PTSD.²⁶ Psychological debriefing is a brief crisis intervention usually administered to individuals within days of the onset of the disaster. It also can be provided to a group of individuals over a three-to-four hour period. However, most studies have failed to show any beneficial effect of psychological debriefing and two studies demonstrated that the process actually can impede recovery.²⁶ For example, 13 months following a disaster, assessments of individuals who had received psychological debriefing and a control group of individuals who had not received the intervention revealed a significantly higher incidence of PTSD in the group that had received the intervention (26%) as opposed to the control group (9%).²⁷ Hobbs *et al*²⁸ conducted follow-up assessments of victims three

years after a traumatic event; those who had received psychological debriefing were markedly more symptomatic than those who had not had the intervention. These authors concluded that psychological debriefing is not effective and has adverse long-term effects.

Other studies similarly have found limited evidence that debriefing has any impact on the development of PTSD, and some evidence that a small proportion of people who undergo this intervention become worse, in the long term.²⁹ As a consequence, the routine use of single-session psychological debriefing is not recommended.³⁰

Bereavement and Grief

Bereavement and grief are experienced when a loved one (partner, child, parent, relative, friend) dies. Bereavement is normal; we all must deal with death throughout our lifetime. However, during a disaster, the number of losses may be much greater and the rituals associated with death (e.g., funerals and viewing the deceased person's body) may be disrupted while access to support is limited. These factors can affect the normal bereavement process and contribute to mental health complications. Childhood traumatic grief (CTG) describes a condition in which children who lose loved ones in a traumatic manner develop PTSD symptoms that interfere with their ability to fully grieve their loss.³¹

Bereavement processes are highly individual and vary across cultures; there is no right or wrong way to grieve. Bereavement following an event that results in a disaster can be more complex, particularly if there is a disruption to the usual rituals of grief, such as burial or support structures. The majority of people recover naturally from grief with no intervention. People who are bereaved are in pain, and they may cry easily or feel distressed. They may be angry and, indeed, that anger may be projected towards the disaster responders who are trying to assist them. As a consequence, disaster responders may be exposed to criticism, abuse, and even violence.

While disaster nurses cannot take away the pain associated with loss, they must be comfortable communicating with people who are bereaved. The use of active listening skills, providing information and support, encouraging the expressions of grief, and facilitating culturally appropriate bereavement rituals are ways to support recovery.

A small number of people may develop a mental health issue, such as depression, that requires further treatment or referral to an experienced counselor or mental health worker.

Alcohol and Other Drug Problems

Following an emergency or disaster, some people may increase their use of alcohol and other drugs. This is particularly likely in communities with easy

access to alcohol and other drugs. Specific symptoms exhibited by the abuser will depend on the type and quantity of the substance that the person is using. It is important that disaster healthcare workers are aware of the type of substances (both legal and illegal) that may be used by people in their community and routinely ask people about substances they are using. Interventions for people misusing alcohol or other drugs include:

- Building rapport with the person so that they feel comfortable discussing their use of alcohol or other drugs; avoid being judgmental of a person's substance use. Reframing questions from "do you drink alcohol" to "how much alcohol do you drink" often can elicit more accurate answers;
- Providing information about the negative effects of alcohol or other drugs;
- Assisting the person to deal with some of the negative consequences associated with alcohol or other drug use (e.g., obtaining sufficient food each day);
- Assisting with any physical or other mental health problems, such as depression, that might be associated with the use of alcohol or other drugs; and
- Identifying ways and means for the individual wishing to stop alcohol or drug use to do so (e.g., determining the likelihood of withdrawal, identifying and locating available treatment services and self-help groups, such as Alcoholics Anonymous, in the area, suggesting that they avoid friends who use alcohol or drugs, enlisting the support of family members, and avoiding situations in which alcohol or drugs are likely to be available).

TELEPHONE COUNSELING FOR DRUG USERS IN BOSNIA AND HERZEGOVINA

The number of drug users in Bosnia and Herzegovina increased after the war, with an estimated 3,000 drug addicts in Sarajevo alone. To assist young people with drug problems, a telephone counselling program was established. Thirty-four volunteer students were given training and supervision to respond to callers. While the majority of calls have been from concerned parents, the program is planning to expand to provide more assistance to children who may be at risk of developing drug-use problems.³²

Suicide

The data are conflicting regarding the incidence of suicide following a disaster, with some studies citing an increase in the suicide rate,³³ and others finding a decrease.^{34,35} Whether the reported increases are due to co-existing factors

(such as loss of family, home, job, or access to their usual psychotropic medications) is not clear. Certainly, the pre-existence of, or post-disaster development of mental health problems, such as depression and alcohol misuse, often are associated with suicidal thoughts.

When a person has suicidal thoughts, the initial priority is to ensure that the person is safe and out of immediate danger. If possible, involve a relative or friend who is aware of the person's feelings and able to stay with him/her; remove dangerous objects, such as poisons and knives. Before sending the person home, make an appointment within a few days and ensure that he/she agree to be seen again. If the person fails to attend the scheduled appointment, visit them at home or contact a family member to make sure they are all right. People with persistent suicidal thoughts or those who make serious suicide attempts should be referred to a mental health counselor for further assessment and treatment.

JUDGING THE RISK OF SUICIDE ATTEMPTS

While it can be difficult to predict whether a person will attempt suicide, the following factors should prompt concern:

- Past suicide attempts;
- Ongoing sense of hopelessness for the future;
- Limited social support;
- Severe physical illness;
- Continuing suicidal thoughts;
- Presence of severe depression;
- Heavy alcohol use.

Adapted from Patel, 2003²²

MENTAL HEALTH ASSESSMENT

A mental health assessment should be an integral component of all health assessments. While the amount and type of information collected will vary depending on the context, nurses must be able to conduct a mental status assessment as part of a health interview in order to assess risk factors and safety concerns, and determine available support systems. Key features of a mental health assessment include:

- *Appearance and behavior* — How is the person dressed, do they appear relaxed or are they pacing, does the person maintain eye contact during the interview?
- *Speech, both form and content* — Can you understand the person when they speak, do they stutter, are they preoccupied with the disaster, do they avoid discussing the disaster?
- *Mood, i.e., what feeling(s) the person emotionally communicates* — A person may say that they feel fine, but they may communicate a sense of sadness, despair, or even anger.

- *Thoughts, including any abnormal or delusional thoughts* — Are thoughts pressured, for example do they speak rapidly or is it difficult to interrupt a person's flow of speech?
- *Perceptual disturbances, such as hallucinations* — Is the person hearing voices, receiving messages through a radio or being controlled by an external source? Perceptual disturbances can suggest a serious mental health problem; consider referring anyone with abnormal perceptual experiences for further assessment.
- *Cognition* — How is the person's memory; are they able to concentrate?
- *Insight* — What is the person's sense of what is happening to them? Are they denying any symptoms of stress?

PSYCHOLOGICAL FIRST AID

Psychological first aid refers to “Pragmatically oriented interventions with survivors or emergency responders targeting acute stress reactions and immediate needs. The goals of psychological first aid include the establishment of safety (objective and subjective), stress-related symptom reduction, restoration of rest and sleep, linkage to critical resources, and connection to social support.”³⁶

Psychological first aid is an initial intervention that involves approaching the victim, offering support and reassurance, and offering safety, comfort, and communication.³⁷ It aims to alleviate painful emotions and promote hope for victims of disasters. Psychological first aid is intended for use by mental health professionals and first responders such as nurses. The primary objective is to create and sustain an environment incorporating the following characteristics:³⁸

- *Safety* — helping people meet basic needs for food and shelter; obtaining emergency medical attention, where necessary; and protecting them from further harm;
- *Calm* — listening to people who want to share their stories and emotions; being friendly and compassionate, even with individuals who may be difficult; and offering accurate information about the emergency and relief efforts underway;
- *Connectedness to others* — helping victims contact friends/loved ones, reuniting and keeping families together, where possible, and connecting victims to available community resources;
- *Self-efficacy/Empowerment* — providing practical suggestions that guide victims towards helping themselves and being able to meet their own needs; and

- *Hope* — determining the types and locations of governmental and non-governmental services and directing victims to available services; and informing them if further help and services are on the way when they express fear and worry.

PROBLEM-SOLVING COUNSELING

Nurses can help disaster survivors by providing counseling that assists them with finding solutions to their problems in a systematic way rather than avoiding the problems or reacting to the problems inappropriately and unproductively. Solving specific problems can be facilitated by following these steps:³⁹

1. Identify the problem;
2. Identify alternative solutions through brainstorming;
3. Compare the pros and cons of each solution;
4. Identify the most suitable solution; and
5. Implement the chosen solution.

Psychological first aid techniques can be taught quickly to both volunteers and professionals. However, these techniques should not be used if they are not warranted. If people wish to talk about their experience, this should be supported, but it is not appropriate to probe for psychological responses in the immediate aftermath of the disaster.³⁷

When confronting intense emotions, the nurse should communicate calmly, using a soft, welcoming, comforting voice, and attempt to establish a positive relationship with the person. Using concrete, closed-ended questions often can facilitate communication with a person who is distressed. It is important to remain calm and professional, particularly with those persons

PRACTICAL SUGGESTIONS THAT CAN BE MADE TO INDIVIDUALS FOR PSYCHOSOCIAL WELL-BEING

Nurses can help disaster survivors by providing counseling that assists them with finding solutions to their problems in a systematic way rather than avoiding the problems or reacting to the problems inappropriately and unproductively. Solving specific problems can be facilitated by following these steps:³⁹

- Stay away from danger, but remain in familiar surroundings with close family members;
- Begin reconstruction of physical infrastructure as soon as possible;
- Avail of all possible government and other assistance;
- Listen only to authentic and reliable information;
- Return to your daily routine as soon as possible;
- Share your feelings and experiences; do not try to suppress your emotions;
- Try to help others by participating in relief and rehabilitation operations;
- Take time to relax and engage in some pleasurable activities, such as meditation, prayers, music, or movies;
- Do not consume excessive amounts of alcohol or sedative medications; and
- Eat healthy foods and get sufficient sleep.

who are agitated or threatening. If a person does become threatening, seek assistance. Do not force people to share their stories, make promises that may not be able to be kept, or tell people how they should be thinking or feeling.³⁸

PRE-EXISTING SEVERE MENTAL DISORDERS

People with severe mental disorders, particularly those living in custodial settings, are particularly vulnerable during a disaster. Living in custodial environments isolates people from the protection of families and communities, and they may be abandoned or left unprotected by staff in the aftermath of an emergency. Disaster interventions should focus on their protection and the re-establishment of basic care, including the provision of clothing, food, shelter, access to physical treatment(s), and continuity of psychiatric treatment (including medication and psychosocial support).

MENTAL HEALTH NEEDS OF CHILDREN AND YOUNG PEOPLE

Nearly all children and adolescents who have experienced an emergency or disaster situation initially display symptoms of psychological distress. However, most will recover once their basic survival needs are met, safety and security are returned, and developmental opportunities within the social, family, and community context are restored.⁴⁰ In general, caregivers should be attentive listeners, help children cope with their experiences, and identify those children who need professional mental health support. Such children may manifest some of the symptoms listed in Table 26.4, as well more dangerous behaviors.

DURING THE 1990s, Sierra Leone suffered from acts of war over many years, resulting in a high level of exposure to distress and trauma.⁴¹ The psychosocial recovery of children was based on four basic and equally important strategies that proved to be effective in this situation:

- Supporting family reunification;
- Ensuring access to education, health, and other basic services for all children;
- Supporting the psychosocial recovery of children in distress; and
- Promoting family and community mediation.

A small number of children were severely affected by the combat situation in Sierra Leone and required specialized care. A National Referral Network was established with the Christian Children's Fund providing basic skills in psychosocial support to more than 600 workers in Sierra Leone. Strong coordination links were established between all psychosocial programs in the country with the national network functioning as an interagency psychosocial support system where agencies complemented each other in order to provide children with the services they needed at a different level of intervention.

AGE GROUP	INTERVENTION
0 – 3 years	Give verbal reassurance and provide physical contact If the child fears being hurt, reassure them that you will keep them safe Maintain routines, such as bedtime Limit exposure to media reports of the disaster
Preschoolers	Reassure them that they are safe Understand that there may be regressive behavior (e.g., bed wetting, wanting to sleep with parents) but limit aggressive behavior Encourage the expression of grief through play Limit exposure to media reports of the disaster
School-age children	Give additional attention Listen to repeated stories of the disaster, and answer questions honestly without false reassurance Explain normal emotional reactions to disasters Encourage play or practice routines that encourage a sense of safety (e.g., practice evacuation drills) Use peer support strategies (e.g., discuss disaster with peers at school) Limit exposure to television
Adolescence	Relax expectations of performance Encourage discussion with peers and significant adults Explain normal reactions to disasters Encourage physical activity Encourage resumption of normal routines and participation in community rebuilding activities

Table 26.5: Examples of effective interventions for children and adolescents affected by disasters²³

For children and adolescents, all psychosocial interventions should be directed towards maintaining or re-establishing their normal developmental processes.⁴⁰ A prospective study of adolescents five years after experiencing an earthquake in Armenia revealed improvement in PTSD scores and symptoms of depression in victims who had received brief trauma/grief-focused psychotherapy compared to those who had not.⁴² Interventions that promote psychosocial recovery for children and adolescents should be age-appropriate. Table 26.5 provides a summary of effective psychological strategies for children of different age groups.

MENTAL HEALTH NEEDS OF THE ELDERLY

Several factors contribute to the fact that the elderly represent a disproportionately high number of the victims of a disaster. Some of these factors include

locomotor, cognitive, and sensory impairments, health conditions, and socioeconomic constraints. Elderly disaster victims may experience severe reactions to losses that they spent a lifetime achieving, with little time or resources left to replace them. They may lose family members as well as essential support systems. For some, such losses may represent a tipping point in terms of their ability to function independently.

The data on a disaster's effect on the mental health of this population are inconsistent. Some have noted less psychological impact on the elderly than other age groups, perhaps as a result of their life experiences and the sense that they have already experienced much loss;⁴³ others indicate the elderly suffer more psychological distress than younger victims.⁴⁴ Among older adult survivors of a flood, those with strong social support systems experienced less depression than those with weaker support systems.⁴⁵ However, older people may be less likely to reveal their anxiety or fear and consider a stigma associated with mental health services; disaster nurses and other healthcare providers must proactively seek evidence of signs of trauma in assessing this population. In the aftermath of a disaster, recruiting the expertise of the elderly, when possible, can be of great benefit to victims; older adults who have experienced disasters in the past can be extremely helpful in providing strength and assurance to other older adults.

MENTAL HEALTH NEEDS OF DISASTER HEALTHCARE WORKERS

While nurses and other healthcare workers will be responsible for responding to the mental health needs of communities after a disaster, they, themselves, may be adversely affected. The negative impacts include not only the problems associated with the disaster, but also exposure to the impact of the disaster on others, the disruption of the healthcare system, and social and political instability. For example:

- The disaster healthcare worker may experience personal losses, including emotional (e.g., bereavement), physical (e.g., destruction of homes), economic (e.g., loss of income), or social (e.g., disruption to support networks) losses;
- The healthcare worker's family or community may be adversely affected;
- The healthcare system may be affected, resulting in loss of employment, disruption to training programs, deterioration in work environments, and reduction in staff as well as professional standards. Internal displacement can result in overstaffing in secure areas and desertion in insecure areas;⁴⁶
- The political system may be affected resulting in political

instability and even a change of government. This political instability may disrupt the healthcare system;⁴⁶

- The security of healthcare workers might be affected thereby exposing them to an increased risk of violence, particularly if the political stability of the country has been compromised; and
- The devastating effects of witnessing the impact of the disaster on others (e.g., observing the burial of people in mass graves, the inability to meet the health needs of large numbers of injured people, witnessing the death of children) also can have a negative effect on the mental health of the disaster responder.

NURSES WERE ON THE FRONT LINE from the moment the tsunami struck

Southeast Asia on 26 December 2004.⁴⁷ Most hospitals and health centres in the impacted areas were destroyed or extensively damaged. Working in poor conditions, nurses did all they could to care for survivors. They also provided essential health care to those with chronic illness and/or disabilities who suddenly became vulnerable because they lacked access to essential medicine and care. Nurses had to manage a very large number of dead bodies: more than they had ever seen in their entire careers. Also, they provided care and counselling to the thousands of survivors who lost children and other family members. They did all of this while coping with their own personal losses and bereavement.

It is essential that nurses understand not only the symptoms of stress, but are able to use the following simple strategies to reduce its negative impacts:⁴⁸

- *Do not try to do too much* — While there often is too much to do during a disaster, it is important to recognize that nurses are human, and cannot do everything. It is important to know when to stop, slow down, or take a break;
- *Work with others* — Working with others is an effective strategy to reduce stress. Work in pairs, ask your colleague to assist you with difficult or distressing tasks, or work with other members of the health team or lay people who may be assisting in the emergency;
- *Talk about your experiences* — Talking about your experiences and feelings may reduce the likelihood that you will experience PTSD. Identify a person you trust or attend support activities with other emergency response workers;
- *Acknowledge your achievements* — Even though the tasks after an emergency may seem overwhelming, it is important to recognize what you do and/or accomplish;
- *Take regular breaks* — It is essential to take regular rest breaks and leave your post. Avoid working continuously — everyone needs a day off to relax;

- *Look after your physical health* — Ensure that you eat a balanced diet, have sufficient sleep, and avoid alcohol and other drugs;
- *Stay in contact with your family* — Family support is essential and it is important that you maintain contact with your family, even if they are a long distance away. Telephone calls, photographs, letters and emails can help keep you connected to your family; and
- *Seek counseling* — If symptoms of stress are distressing or persist, speak with a counselor. You will not be able to support the emotional needs of patients unless you look after your own mental health.

It is crucial to consider the work environment during a disaster, and, to the extent possible, ensure that it is a safe and healthy workplace. For example, work shifts should not be excessive in length and the workload should be rotated between high-, mid- and low-stress tasks. It is essential that there are sufficient breaks both within and between shifts to ensure time for adequate nutrition and rest. Communication is critical, and regular staff meetings should be conducted. The team approach to relief work is necessary to avoid emphasis on an individual's responsibility or role in rescue operations.

A clear organizational structure with defined roles and responsibilities for all staff has been shown to reduce the potential for negative psychosocial effects among responders.⁴⁹ Nurses should have information on their job role and clear reporting accountabilities. Role overlap or blurring should be avoided, when possible. As members of the healthcare team, nurses must be cognizant of the potential effects of relief work on their team members and be vigilant to the signs and symptoms of mental distress among them. For example, partnering experienced workers with inexperienced workers through a buddy system, and rotating workers between high-stress and low-stress situations can minimize stress.⁵⁰

IN ONE AIR CRASH, more than 80% of the response workers who had to deal with the bodies of the victims showed some signs of post-traumatic stress. Almost two years after the crash, one-fifth (20%) of these workers still were suffering distressing symptoms.⁵¹

Providing support to nurses and other healthcare workers returning to work after a disaster can increase the available human resources, reduce reliance on external health professionals who have responded to the disaster, and aid recovery of the local community. It is essential that the basic needs of nurses (and their families) be met before they return to work. Unless people have a safe place to live, have food to eat, and have their emergency health needs met, they will not be able to return to work. As many health workers

are women, issues of child care may emerge, particularly if there is social dislocation and people do not have their usual support structures. Nurses will not be able to return to work unless their children (and other dependents) can be cared for safely.

CONCLUSION

The effects of disasters on communities are widespread and can include destruction of infrastructure, absent or limited electrical power, sanitation, and water, absent or limited contact with the outside world, dissipation of the community due to death and injury, vulnerability and exploitation from the media, and the potential for recurrence of the disaster.

The contribution to the psychosocial recovery of survivors of emergencies begins during the emergency preparedness and planning stage to ensure awareness of survivors' possible reactions and the ability to recognize "normal" responses from symptoms that may require referral and further treatment by specialists. The use of social interventions effective in minimizing the potential for serious mental illness are essential in caring for these victims. Nurses working in this area also need to be conscious of their own vulnerability and the need to take care of their own psychosocial recovery to avoid a lasting impact. Ensuring that health workers have the skills and knowledge to effectively respond and contribute to the psychosocial recovery of disaster survivors is critical, particularly as an increasing proportion of the population are at risk of being exposed to a disaster or catastrophe.

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CHAPTER 27

DISASTER ETHICS

Leila Toiviainen and Elaine Daily

THE EXTREME CONDITIONS of disaster situations present ethical challenges for which nurses must prepare before confronting them in their practice. Examples of such real-life events in the recent past include the bushfires in the state of Victoria, in Australia, in February 2009, Hurricane Katrina in New Orleans, the United States, in 2006, the Severe Acute Respiratory Syndrome (SARS) epidemic in Taiwan in 2003, and the Gujarat, India, earthquake in 2001. The aftermaths of all of these events revealed substantial gaps in preparation by health professionals and healthcare institutions that still impact on these communities. This chapter is an exploration of how nurses, as members of communities and the healthcare profession, can prepare for disasters in ways that can alleviate the losses experienced by the victims of disasters. They can do this by understanding their ethical obligations as health professionals under normal circumstances, and how these obligations must be adapted while continuing to practice in an ethical manner in emergency and disaster conditions.

OBJECTIVES:

- To understand the basic principles underlying ethical decision-making;
- To appreciate the need to prepare for and practice ethical decision-making during a disaster; and
- To describe the ethical issues that may arise affecting one's ability to respond to persons in need during a disaster.

Nurses need to understand their professional codes of ethics, not only in their countries, but also in the countries in which they may work. They need to be aware of the cross-cultural issues related to religion, gender, and particular cultural practices that either can diminish or enhance their contribution to the individuals and communities in need during and after disasters. Nurses must develop not only good clinical skills, but also good ethical skills to guide them in their daily practices as well as in times of disasters, when they may be most needed.

BIOETHICS DEVELOPMENT

Ethics is the branch of philosophy concerned with the moral virtue of human actions. It is a way of thinking about behavior and the principles that guide it. Morals refer to some standard or code of behavior established by a society, a philosophy, a religion, an authority, and/or an individual. Throughout the ages, philosophers have attempted to find answers to questions of how we should live and how we should treat other people. Ethics may agree with morals, or some moral code, but not necessarily.

Bioethics is concerned with questions of how healthcare professionals should make ethical choices when confronted with complex issues in the care of humans. During the 1970s, new technologies and improved methods of life support made the transplantation of organs possible, thus requiring doctors to make decisions about who should and should not receive them. At the same time, individuals inspired by the consumer and women's movements began to question the decisions of small groups of professionals and began to demand alternative treatments and more open communication as equals.¹ Philosophers express this trend as a move from paternalism, in which the professional holds the position of the father who knows best, to autonomy, in which individuals are free and capable of making their own choices. The most common topics of bioethical discussion in the 1970s, and ones that continue to attract our attention, are abortion and euthanasia — issues that relate to free, individual choices. During the last decade, the focus of bioethicists has been on biotechnology; both consumers and healthcare professionals are concerned about the uses and effects of biotechnology in the genetic modification of plants and the genetic testing and enhancement of human beings.²

While the origins of modern bioethics are thought to date back to the Nazi era of human experimentation without consent, the post-war developments of organ transplant surgery, technological advancements, and *in vitro* fertilization have resulted in ethical dilemmas in all areas of health care. However, Boyd maintains that the real ethical question to be asked is not just what medicine *could* do, but what it *should* do for individuals and groups.³

APPROACHES TO ETHICAL THINKING

Contemporary philosophers have formulated various guidelines to assist healthcare professionals in ethical, clinical decision-making. Some of these ethical rules are based on the moral theories of philosophers such as Aristotle, Immanuel Kant, and John Stuart Mill. The two primary methods used in ethical decision-making in health care are the teleological and deontological approaches.

Teleological Approach

Teleological methods of ethical decision-making are based on the principle of

utilitarianism originated by Jeremy Bentham and refined by John Stuart Mill.⁴ These philosophers believed that moral decisions should be made on the basis of what actions provide the greatest amount of happiness (or good) to the greatest number of individuals. According to teleological thinkers, the moral character of actions depends on the extent to which actions actually help or hurt people; actions that provide more benefits than harm should be chosen over those that lead to fewer benefits and more harm. Furthermore, while everyone's happiness counts, no one person's happiness counts for more than another person's happiness. Thus, a teleological outlook takes a pragmatic, common sense approach to ethics that is objective, fair, and open. This moral theory is used widely in healthcare decision-making, especially during times of disasters when concerns of a population take precedence over individual concerns.

Deontological Approach

In the eighteenth century, Immanuel Kant connected morality with rationality. He argued that any rational person would be able to understand his/her moral duties and would perform all such duties without regard for the consequences of these moral acts. Likewise, individuals would expect others to act in similar moral ways; rational moral acts would become the universal norm. This moralistic behavior also would show respect to individuals; they would be treated as ends in themselves, with their own dignity, and not just as a means to someone else's ends. This ethical approach, termed *deontological* (from the Greek *deon* meaning *duty*), is duty-based, and includes actions that are one's duty to do, and actions that are one's duty to avoid. Such fundamental, ethical, right and wrong duties are best depicted by the Ten Commandments and Human Rights.

The implications of using the utilitarian approach to disaster triage means that some very ill patients are sacrificed, i.e., not treated, so that larger numbers of patients with better chances of survival can be cared for most efficiently. However, as pointed out by Veatch, the American liberal political philosophy tradition is based on the principle of justice.⁵ According to the principle of justice, each individual should be treated equally, and the society should ensure that those least well off should be as well off as possible in comparison with those that are better off. Veatch suggests that these kinds of ethical dilemmas can be solved only by full-scale public debates, rather than by leaving the decision-making either to healthcare professionals or lay people. All concerns, including the regard for those who are the worst off during a disaster, should be taken into consideration, even if the result might be a political compromise that fails to satisfy anyone entirely.

The difficulties posed by the irreconcilability of two sets of moral principles also is discussed by White *et al* in relation to the allocation of life support

during a public health emergency.⁶ They argue that during such an emergency, the common good overrides arguments for individual autonomy. They point out that if ethical and practical dilemmas remain unsolved, the responses to public health emergencies will fail. For this reason, they also argue for the need for meaningful public engagement so that some kind of compromise between utility and the principles of justice and autonomy can be reached prior to the disaster situation.

Because of the apparent conflicts between theoretical principles as guidelines for practice, some philosophers have argued that old theories cannot be applied to current problems that could not have been foreseen by men living centuries ago; new approaches to problem-solving are required. Some philosophers, in collaboration with clinicians, contend that medicine and nursing fundamentally are about encounters between human beings, no matter how scientific or technical the setting. For this reason, they argue, no sets of rules can be applied to any particular situation; each situation must be assessed as unique. Jonsen and colleagues propose that the ethics of clinical dilemmas should be analyzed in relation to four topics: (1) medical indications; (2) patient preferences; (3) quality of life; and (4) social, economic, legal, and administrative contextual features.⁷ However, it has been argued that clinical ethical dilemmas arise as a result of unjust institutional policies and programs, rather than from individuals or groups of people.⁸ But, it takes time to change established institutional policies; in clinical practice, time is of the essence and crucial ethical decisions must be made immediately. Morally sound, practical, and ethical skills are needed to accomplish this.

The most influential theories aimed at solving the complex problems of modern health care are based on the four principles developed by Beauchamp and Childress in response to the need for rapid ethical decisions in clinical situations.⁹ These four principles are: (1) respect for autonomy; (2) beneficence; (3) non-maleficence; and (4) justice. Respect for *autonomy* refers to respecting an adult individual's right to voluntarily make their own decisions regarding their health. *Beneficence* refers to doing good, i.e., doing what is most beneficial to the patient without regard for personal gain. *Non-maleficence* refers to not causing harm to the patient through acts of commission or omission; it may also include acts to reduce the risks of harm. *Justice* refers to the equitable distribution of goods and services.

Both healthcare professionals and philosophers have posed numerous arguments for and against the use of these principles in theoretical and practical situations. For example, most doctors and nurses, as well as consumers of health care, would agree that mature adults should be able to make decisions for themselves about their health, as long as they do not harm anyone else by their decisions. Thus, their autonomy should be respected. However, not all adults are

able to do this; they make choices that harm themselves, they may exercise their autonomy by refusing treatments that would enhance their quality of life.³ The care of children poses even more difficult ethical challenges. For example, parents who refuse to give permission for their child to receive a necessary blood transfusion because of religious beliefs are exercising their autonomy in ways that prevent doctors from being beneficent, non-maleficent, and just.³

Nonetheless, nurses must be aware of the core bioethical theories and their limitations in ordinary healthcare situations; in disasters, these limitations may be exacerbated as the focus of care necessarily must be on groups of vulnerable individuals in urgent need of care. Because of the scale of deprivation and the limitations on available resources, decisions must be made on bases other than the demands for autonomy and individual justice.

ETHICAL PREPARATION FOR DISASTERS

How can nurses make the best possible choices as individuals and as professionals? The choices we make are in accordance with the values we hold; these we may have inherited from our parents, from a religious upbringing that influences our decisions about right and wrong, and/or from role models, such as friends or educators. The laws of the country we live in govern some of our choices; there are certain things we cannot do because they are illegal. We must behave in accordance with the rule of law.

Many healthcare professionals hold altruism as their guiding value; they want to help other people. The late Mother Teresa as well as the doctors and nurses working for Médecins Sans Frontières are examples of altruistic people. While most nurses and doctors may not be prepared to sacrifice as much as these exceptional individuals, most careers in health professions involve some personal sacrifices, such as long hours spent in training, and the loss of some leisure and social time. They are not careers for those who are egoists only.

In most countries, nursing practice is guided by a professional code of ethics. Most codes of ethics contain instructions on how nurses should treat their patients, i.e., they should be treated with dignity, their confidentiality should be maintained, and their cultural values should be respected. Patients should be treated as individuals and as equals. In most instances, the professional code re-presents the ideals of nursing, the standard to which each individual nurse should aspire. However, research conducted by European nurse educators demonstrated that, in general, nurses are not aware of the content or the significance of their professional codes of ethics, and that these codes do not influence their moral thinking in patient-care situations.¹⁰ Rather, nurses are guided by their prior experiences with old lessons being applied to new situations; in some instances, the clinical practice of nurses is determined by the culture of the organization in which they work. While many of the nurses'

answers to the survey questions were contradictory, most disconcerting was the nearly unanimous claim that the codes were in place to protect the public. Many thought that patients had too much power and patients' rights were thought to interfere with the provision of nursing services! In other words, the practice of European nurses, as reported by these researchers, is unreflective and lacking in creative responses to new situations. The ability to make quick decisions and to "think on your feet" are vital in disaster situations. Nurses can do this only if they have developed ethical skills, such as listening to the patients and respecting their needs in their everyday practice.

In times of a disaster, nurses have provided relief responses in other countries throughout the world. However, in order to optimize their abilities and to best serve their patients in the host nations, nurses not only must develop their clinical skills and knowledge, but also their knowledge of the codes of nursing ethics of the countries in which they are working.¹¹

The American Nurses Association (ANA) Code of Ethics specifies that the nurse is obliged to provide for the patient's safety and that withdrawal from providing care can be done only when it is assured that alternative nursing care is available to the patient.¹² However, nurses must keep in mind the limitations of any professional codes of ethics:

Declarations and codes are useful in that they provide generalized guidelines. They have their limitations, particularly where specific issues are tested against them. The nursing codes direct; they do not protect. They stimulate thinking but they do not provide walls within which it is safe to act. In the overall scheme of an ethic of caring they state perhaps the obvious, or the implied, but they also sharpen the perception of care.¹²

A Finnish study of the views of nurse educators and nursing students regarding the teaching and learning of nursing codes of ethics suggests that ethics becomes more meaningful to nurses if they can use ethical approaches that are based on relationships between people, rather than basing them on abstract theories about how to treat individuals.¹³ The latter approach tends to emphasize compliance with a set of rules, whereas discussions of relationships based on the nurses' own experiences followed by the application of the theories fosters a true commitment to morality.¹³ Nurses need a commitment to morality based on the ethical reflection of experiences in order to provide care under extreme circumstances to persons from cultural backgrounds different from their own. Reflection on the needs of others also can result in the realization that, although we may differ from those living in other countries, we share the same needs for food, drink, shelter, and security and, therefore,

we share the same ethical values related to our common humanity.¹⁴ As nurses, it is our duty to affirm human dignity, show respect for the values and customs of others, and to configure care practices that reflect our awareness and sensitivity of others’ values.

THE CHALLENGES TO ETHICAL PRACTICE DURING DISASTERS

Likely, the two greatest ethical challenges faced by nurses during a disaster concern the need to prioritise and allocate scarce resources and services, and the nurse’s duty to care. During a pandemic or other biological event, issues regarding the restrictions of personal liberty also may be ethical challenges facing some healthcare personnel.

Prioritizing the Allocation of Resources

An overarching issue during a disaster is the scarcity of available resources. The allocation of these scarce resources must be done in an ethical way that takes into account the demands of justice, as well as the commonly advocated principle of the “common good”. Because of the magnitude and scope of a disaster, decisions regarding the allocation and distribution of services and re-sources must shift from the usual, individual patient approach to a population focus, as differentiated in Table 1. This principle forms the basis of disaster tri-age — “a process designed to prioritize casualty care at the scene of an incident to ensure care is available to those who need it most urgently and that the greatest number of casualties survive.”¹⁵ Nonetheless, patients are assessed one by one, and care and treatment decisions must be made for the individual patient, while considering the needs of the population. Some practical guidance for this difficult task has been developed by a New Zealand professor of emergency medicine.¹⁶ The guide consists of seven sequential questions to be asked relative to a patient’s clinical status and available resources; the answers to these questions direct the decision regarding patient access to limited resources (Table 27.2). Other guidelines have been developed relative to the allocation of critical care resources during a pandemic or

ETHICAL DECISION-MAKING DURING USUAL PRACTICE	ETHICAL DECISION-MAKING DURING A DISASTER
Individual focus Individual choice For the good of the individual Time to consult/discuss	Population focus Population-based choices For the good of the population — not necessarily good for every individual No time for consultation/discussion

Table 27.1: Differences in clinical decision-making in a disaster compared to usual healthcare practice

QUESTION CATEGORY		QUESTION	ANSWER/RESPONSE
1.	Normal threshold	Does the patient meet the clinical criteria for access to the resource during normal times (i.e., when there is not overwhelming demand for the resource)?	Yes — proceed to question 2 No — no access to the resource
2.	Competition	Are there other patients who meet the normal clinical criteria that are competing for the same insufficient resource?	Yes — proceed to question 3 No — allow access to the resource
3.	Alternative options	Can any of the competing patients (including those who are already using the resource) receive an alternative treatment/care that will provide reasonably similar benefits to the patient and not cause significant harm?	Yes — provide the alternative treatment/care resource No — proceed to question 4
4.	Deferability	Can any of the competing patients defer access to the resource to a future time when demand is likely to be less, without coming to significant harm?	Yes — defer access to the resource No — proceed to question 5
5.	Expansion question	Can the resource be expanded to accommodate greater access (e.g., redistributing resources from services not experiencing overwhelming demand or from services that can be deferred without significant harm to patients)?	Yes — expand resource; return to questions 1–4 No — proceed to question 6
6.	Mitigation	Are there any alternative treatment/care options for any of the competing patients that will mitigate the harm of missing out on the resource in question?	Yes — consider the effectiveness of alternative options No — proceed to question 7
7.	Ranking	Of those patients competing for the resource (including those who are already using the resource), rank them in order of perceived net benefit of accessing the resource (i.e., sum the estimated benefit of having the resource and the harm of not having the resource taking into account any mitigation of harm from the options identified in question 6.	Patients with highest net benefit rank should access resource first; if net benefit cannot be differentiated, use another fair, unbiased method of determining resource access

Table 27.2: Criteria for prioritizing access to resources during a disaster (Modified from Ardagh¹⁶)

bioterrorist attack.^{17,18} However, because this represents a deviation from normal healthcare practice, and in the issues of justice, fairness, and trust, pre-established resource restriction guidelines and triage systems must be known and, for the most part, accepted by the individuals on whom they will be used. This requires open discussions with, and input and buy-in from, the community representatives and stakeholders.

Duty to Care

As members of society, nurses have the same duties as other citizens. However, in choosing a career within the healthcare profession, nurses, as well as other healthcare professionals, assume certain risks and challenges that other people do not have to confront. In their professional life, nurses are confronted daily by difficult choices; the choices not only affect themselves and those closest to them, but also their patients and those involved with their patients. In other words, nursing practice affects whole communities and societies, and therefore, carries a heavy burden of responsibilities. Nurses are concerned not only about their own flourishing as individuals, but also for the well-being of large groups of people.¹⁹ Historically, nurses have responded to the needs of others in emergency and dangerous situations, often at great personal risk.

However, the concept of duty is complex and, increasingly, nurses are faced with multiple, conflicting duties or obligations. And, while nurses have always been required to incur some personal risk in the course of their duties, personal safety concerns may become heightened in certain disaster situations, as occurred in the SARS epidemic in 2003.²⁰ The ANA provides some guidance in determining an acceptable level of risk: "The benefit the client will gain outweighs any harm the nurse might incur and does not present more than an acceptable risk to the nurse."²¹

However, individual heroism cannot be expected. In discussing nurses' duty to care (also termed *duty of care*) for patients with SARS, Reid argues that rather than focusing on the altruism and heroism of individuals, we need to assess rationally the levels of risk that nurses are exposed to and accept that "obligation sinks with rising levels of risk and there is a level of risk at which the duty to care no longer holds."²² She concurs with others that the determination of the level of risk be a matter of public consultation. Nurses should not be left feeling isolated, either physically or psychologically. She further points out that by their training and their temperament, or what Aristotle would call virtues, nurses often are unwilling to relinquish their duty to care, even if it poses risks to their own welfare. Nonetheless, there are limits to the altruism of healthcare professionals, and preserving one's life is a compelling factor.²³

The American Medical Association is the first professional organization to try to spell out the obligations of physicians during emergencies. Their statement is well-considered, balanced, and though specific to physicians, is applicable to nurses, as well:

National, regional, and local responses to epidemics, terrorist attacks and other disasters require extensive involvement of physicians. Because of their commitment to care for the sick and injured, individual physicians have an obligation to

provide urgent medical care during disasters. The ethical obligation holds even in the face of greater than usual risks to their own safety, health or life. The physician workforce, however, is not an unlimited resource; therefore, when participating in disaster responses, physicians should balance immediate benefits to individual patients with the ability to care for patients in the future.²⁴

Nevertheless, according to a survey of nurses and physicians in Hawaii, only about half of each of the two professions surveyed would report to work during an epidemic threat.²⁵ Likewise, in a survey of 6,428 healthcare professionals in New York City, nearly half indicated an unwillingness to report to work during an outbreak of SARS.²⁶

The question in the minds of many nurses confronted by emergency situations is how these general guidelines advising the balancing of conflicting demands can be put into practice. Again, the ANA provides some useful guidance on how care practices can be adapted under extreme conditions while remaining ethical:

No emergency changes the basic standards of practice, code of ethics, competence or values of the professional. (Legal structures for health professionals MAY change IF the emergency is in a state that allows under such alterations under emergency powers.) The specific application of the standards will be based on the reality of the specific situation, such as the presence or absence of usual equipment, medications or colleagues.²⁷

Clearly, policy guidelines on the duty to care during an emergency or infectious outbreak must be clarified both with regard to the healthcare provider and healthcare employers. Employers have a duty to inform healthcare personnel regarding their expected duty during an emergency, as well to protect and support them in the performance of their duties.²⁸

The Pandemic Influenza Working Group of the Joint Centre for Bioethics at the University of Toronto document has outlined 10 substantive values to guide ethical decision-making during a pandemic.²⁹ Four of these values are especially concerned with the duty to treat patients during pandemics and other disasters, and best express the interdependence of the health professionals and the communities that they serve. They include: (1) the duty to provide care; (2) reciprocity, or society's duty to support those who assume disproportionate burdens to protect the public good; (3) trust, both between patients and providers and between the community and public health authorities; and (4) solidarity among health professionals, within the healthcare facility, within the community, and among nations, in the case of a pandemic.²⁹

Community disaster preparedness planning must include discussions between interdependent professionals and non-professional volunteers as to how far the professionals must risk their lives in order to save others.

We assume, for instance, that in the case of firefighters, community representatives can agree on a level of immediate risk to life that would countermand the duty to re-enter a burning building to try to rescue those trapped inside. If the success of the rescue is highly unlikely, the risk cannot be justified — there is, after all, no advantage simply to having more dead firefighters.²³

However, in comparing the roles of healthcare professionals and firefighters using the decision-making framework of the four principles of autonomy, justice, beneficence and non-maleficence, it is important to note that firefighters are prepared to deal with the fact that they might get killed immediately in their work, which is not what most healthcare workers are prepared to experience in their ordinary course of work.³⁰

Extended discussions and negotiations on the levels of risk that healthcare professionals and their non-professional support workers should be expected to take obviously cannot be undertaken in the midst of a disaster. Communities must engage in these discussions in the preparatory phases, and must involve the open and transparent discussion of the ethical values that will guide their actions in times of emergency. Difficult decisions about individual duties and the allocation of scarce resources must be based on broader and deeper discussions of the most important values held by any particular community. These may display a range and variety of complexity, depending on the demographics. For instance, a small community composed predominantly of older people with similar backgrounds who have dwelt in the same place all their lives might have different priorities than a larger community composed of individuals who have migrated from a range of ethnic backgrounds. In the first instance, there is likely a cohesive community with shared values, whereas the latter instance may represent a less cohesive community with less unity and shared purposes.

Building a cohesive community also requires meeting the challenge of nurturing and maintaining the volunteer workforce that is needed to support health and emergency care professionals in emergency situations.³¹ By nurturing each other, members of a community build the kind of resilience that will equip them, both materially and emotionally, to meet the challenges of a disaster. However, by definition, a disaster occurs when members of one community cannot deal with the enormity of the problems that the event poses, and outside help is required. This can raise additional ethical problems for healthcare professionals and those they serve.

Alterations in Practice Standards

During a disaster, healthcare professionals may need to adapt practices of care by delegating some aspects of care to untrained community volunteers. Pre-event planning, training, and exercises must include these non-professionals. In a critical analysis of physicians' duty to treat patients during a pandemic, Brody and Avery suggest that:

The discussion must be broadened from physicians to include not only all health professionals, but also the non-professional health workers without whom any hospital would soon cease to function. The health care worker's other obligations, especially for the care of family members must be considered alongside duties owed to the patient.²³

The ANA guidelines help nurses set their priorities in disaster situations by defining those actions that are the most urgent and the delegation of those that are less important. The ANA list of the most critical standards that must be met in a disaster includes:²⁷

- Maximizing worker and patient safety;
- Maintaining airway and breathing, circulation, and control of blood loss; and
- Maintaining or establishing infection control (including continuity of medications for conditions such as tuberculosis).

Their secondary list includes actions that can be postponed or delegated to others, if present, such as family members or non-trained volunteers:

- Routine care activities (e.g., blood pressure measurements in non-acute patients, assisted ambulation);
- Administration of oral medications;
- Extensive documentation of care;
- Maintenance of complete privacy and confidentiality; and
- Elective procedures.

The risks to healthcare professionals working in disaster situations often are grave. In normal circumstances, "nurses should be able to work in an environment that is also psychologically, emotionally and spiritually healthy."¹⁴ However, this is not the working environment in most disaster situations. Certainly, this was not the case for the Taiwanese nurses who cared for infected patients during the SARS epidemic of 2003. In addition to the risks to their health and their lives, many of these nurses suffered alienation and discrimination as a result of having cared for the SARS victims. In the aftermath of Hurricane Katrina, nurses attempted to carry out their professional duties in complete darkness, despite hearing gunshots, fearing looters, and fearing for their lives.

ETHICAL DECISION-MAKING

Substantive values to guide ethical decision-making during a pandemic have been developed by the University of Toronto Joint Center for Bioethics Pandemic Influenza Working Group.²⁹ The 10 substantive values they identify and further describe are: (1) individual liberty; (2) protection of the public; (3) proportionality; (4) privacy; (5) duty to provide; (6) reciprocity; (7) equity care; (8), trust; (9) solidarity; and (10) stewardship.

In addition to the 10 substantive values, the group defines five process or procedural values that are interdependent on the above 10 substantive values in ethical decision-making. These values include making decisions in a manner that is: (1) reasonable; (2) open and transparent; (3) inclusive; (4) responsive; and (5) accountable.

One common factor that affects judgment, ethical decision-making, and moral responsibility in disaster settings is fear. Fear of the unknown, fear of making mistakes, fear of doing harm, fear of suffering harm, fear of neglecting one's responsibility, and fear for others may cloud one's reasoning capabilities. Those fears may be exacerbated by fatigue, hunger, misinformation, or misinterpretation.

In 2006, following Hurricane Katrina, two North American nurses were charged with murder. The charge arose as a result of their administration of intravenous analgesia and sedatives to elderly people who died before the hospital was evacuated. However, the context in which the nurses were expected to perform their duties was unimaginably difficult:

After the levees collapsed, the hospital was flooded by ten feet of water. For four days there was no power, no sanitation and no landline phone connections. Staff and patients were in pitch-black conditions with torchlight only. Temperatures reached C40° and drinking water was scarce. Transfer of critically ill patients down several flights of stairs to a helicopter pad in such conditions was described as treacherous and physically demanding for both staff and patients. External communications remained intermittent, and there were mixed messages about evacuation possibilities. Gun-shots were also heard periodically, leading to fears of looters.³²

It is difficult for anyone who did not witness the realities of those extreme conditions to determine the rightness or wrongness of the actions of the two accused nurses. In bioethics, the term *tragic choices* is used when having to choose between two options, neither of which seems right. Although this term is most commonly used in relation to abortion and its tragic consequences to individuals and communities, it also applies to disaster situations

in which both resources and information are scarce, and where decision-making capacities are further clouded by hunger, thirst, exhaustion, and fears about personal safety and the safety of the patients. In other words, if the immediate survival of the individuals is at stake, concerns about future consequences of action take a low priority.

Nurses involved in the SARS epidemic in Taiwan in 2003 experienced numerous fears, some unfounded, some well-founded.³³ According to surveys of the nurses and their understanding of the nature of the epidemic, nearly 59% of the nurses believed that they could not trust the adequacy of infection control measures in place in their working environments; 57% of nurses were willing to care for people infected with avian flu; others were less willing because of concerns about being quarantined after caring for SARS patients, to the detriment of their family and social lives. Regardless of their religious affiliations, 86% of the Taiwanese nurses in the study reported that they relied on the power of prayer and religious support when they or their family members were ill. The authors of the study suggest that improved understanding of SARS provided by in-service education would lessen the fears of nurses. They also emphasized the need for the psychological and emotional support of nurses. The importance of emotional and spiritual support for nurses and the community in cases of disasters and epidemics, where nurses are expected to support victims who fear for their own lives and for those closest to them, cannot be exaggerated.

The role and the ethics of the media during disasters can either help or hinder the work of healthcare professionals; representatives of the media can make disaster relief work easier by transmitting essential information, or they can hinder it by promoting misinformation and alarmist propaganda and generating widespread fear. The headlines that appeared in the Taiwanese and overseas English language press during the 2003 SARS epidemic heightened the fears of both the public and the healthcare professionals.³³

The above examples demonstrate some of the additional demands placed on nurses during disasters. On the one hand, they have the duty to care for their patients; on the other hand, they have the duty to take care of themselves, their families, and their colleagues in order to be able to look after others in the future. Their actions not only come under the scrutiny of other professionals and the public, but, also, the interest of the media, who are particularly interested in stories of sensationalism.

Learning to make difficult decisions in emergency situations can be enhanced through the use of regular drills and exercises that provide opportunities for ethical decision-making and adapting standards. The application of ethical codes of practice must be part of all preparedness plans, as well as disaster drills and exercises. Not only the exercise, but the aftermath analysis

provide experience with and insight into making difficult ethical choices that serve as the essential foundation for ethical decision-making during an actual crisis.³⁴ A vital dimension of a critical ethical reflection on how to act in future emergencies is the realistic appraisal of existing resources that can be used when a disaster situation occurs. The ANA also provides a comprehensive list of “Challenges to Meeting Usual Care Expectations” that should be taken into account in disaster preparedness planning and exercises; these include:

1. Loss of essential services, including electricity, water or the supply chain;
2. Loss of infrastructure, including facilities or electronic information;
3. Shortage of workers due to transportation loss, worker or worker family illness/injury, unwillingness to report to work;
4. Size of the affected population, requiring triage at a community level;
5. Sudden increase in the number of patients, in marked excess of capacity or with elevated Injury Severity Score, or other extreme patient conditions; and
6. Relocation of care to an alternate facility not equipped for patient care.²⁷

NURSES WORKING AWAY from their homes are vulnerable and the possibility of facing criminal charges in a foreign jurisdiction may exist, as happened to 10 registered nurses from the Philippines who were recruited to work in nursing homes in Long Island, New York, in 2007.³⁵ The nurses left their jobs without providing notice because they considered their working conditions to be unsafe. The charges of patient endangerment against these nurses were dropped when the judge recognized that they had been compelled to work in a deplorable work environment without adequate training. Their withdrawal from providing care in such a situation was deemed by the judge to reflect ethical nursing practice.

HUMAN RIGHTS AND DISASTER ETHICS

In 1948, the United Nations adopted the Universal Declaration of Human Rights, which contains 30 articles outlining how people should be treated by their governments and society.³⁶ These human rights are morally and legally binding expectations of individuals and groups in any society and form the cornerstone of humanitarian activities. According to the World Health Organization and the United Nations:

[everyone has a] right to a standard of living adequate for the health and well-being of himself and his family, including food, clothing, housing, and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age, or other lack of livelihood in circumstances beyond his control.³⁶

However, this ideal standard of human rights has not been achieved in most nations in the world during normal circumstances, much less during a disaster. In many places, not only health care but also individual persons are treated as commodities “in a transnational industry that sells or coerces them into a life of exploitation and slavery” with a resultant negative impact on the health of individuals and communities.³⁷

In an excellent exposition of the arguments both for and against the human rights approach to bioethical decision-making, Austin investigates the link between human rights and health, and maintains that “a link between health and human rights may allow us to meet global health challenges in a better way.”³⁷ If all human beings have a right to health, then health care is not a mere commodity to be bought and sold, but a basic provision to which each person is entitled regardless of his or her income or social circumstances.

Beyond individual ethical decision-making is a larger issue concerning the need to develop a viable and just global nursing ethics. Crigger points out that US healthcare consumers and ethicists fail to understand the poverty that exists in many developing countries.³⁸ The community is the only safety net provided for many individuals; abstract arguments about autonomy are not of concern in these situations. She further proposes that nurses must develop new approaches to human rights following Nussbaum and Glover’s models on how to assist those least well-off in the world to develop their “capabilities” to the maximum possible.³⁹

During most disasters, the vulnerable individuals and groups of people within the society are the ones that are exposed to the greatest risks. This was evident during Hurricane Katrina in which those who suffered the greatest were its impoverished citizens, who lacked transportation capabilities to evacuate New Orleans, despite the “mandate” to do so. Even in developed countries, such as North America and Australia, the distribution of basic goods is inequitable. For example, in the aftermath of Hurricane Fran in Florida in 1996, more than one million people were without electrical power, and, thus without the ability to refrigerate food, infant formula, or insulin. Some individuals exploited the situation by renting refrigerated trucks, and selling bags of ice at seven times their usual cost. This dramatic increase in price by sellers in response to a sudden shortage of goods and services as a result of a disaster

is termed *price gouging*.⁴⁰ Were the human rights paradigm used in such a situation, supplies such as ice, food, infant formula, and insulin and other medications, would not have been regarded as commodities with a price set by “free markets”, but rather as basic needs to be provided to everyone as their right to health, regardless of their ability to pay. Scarce supplies would be distributed using triage conducted by trained medical professionals, or encompassing a zero-price-raise system. Although, the difficulties and risks associated with the delivery of some supplies into a disaster zone may result in increased costs, the higher prices of necessary goods must be paid either by the governments or the international organizations responsible for providing the goods, rather than by the poorest victims of disasters.⁴⁰

Methods imposed on individuals in an effort to control the spread of infectious disease, such as mandatory testing and quarantine/isolation, often have infringed upon the basic rights of humans.⁴¹ However, these infringements are lawful and considered to be justified for the sake of the public good and to protect the public from harm. In other words, the rights of individuals (both patients and healthcare professionals) may need to be restricted, possibly unjustly, in order to promote the well-being of the majority; the utilitarian moral theory is the underlying ethical framework for this justification. But such infringements must be weighed and considered carefully and carried out with respect of the fundamental human right of the person’s freedom.

Academicians at the Harvard School of Public Health have addressed many issues related to the perceived violation of human rights by utilitarian policies that focus on the common good. They have developed a tool for policy-makers for the consideration of issues such as clarifying the public health purpose, and guaranteeing fair procedures to those persons affected when a coercive measure is truly necessary to avert a significant risk.⁴² In other words, policy-makers are encouraged to move away from a utilitarian consideration of the majority of both healthcare recipients and providers in disaster situations, toward the consideration of the individuals involved as “an end in themselves, not as a means to someone else’s end”, as expressed by Immanuel Kant.

One obvious argument against the use of the human rights paradigm in disaster situations is that the focus on the individual places an inappropriate priority on the needs of one person at a time when large numbers of people are suffering. From the perspective of many Asian cultures, this type of individualism is a western concept with no counterpart in Asia, where, traditionally, the community comes before the individual. In the eastern culture, human beings are not separate from nature and other living things.

When the differences between cultures are highlighted, it may be concluded that there cannot be any possibility of a global nursing ethics of the kind advocated by some authors. However, whatever our culture, we humans

are not so different; nor are our basic needs different.

Using the human rights paradigm provides a sound basis for ethical decision-making, even in disaster situations. In spite of some of the arguments against it, particularly the critique of Western individualism, our human similarities, rather than our relative cultural differences, are convincingly supportive. If all individuals have the same basic needs, then they deserve the same respect as individual persons while being part of the larger community.

The quality of communicative interactions are central to the effective recognition of human rights. This becomes especially important when working in an international setting or in a cultural setting different from our own. In many societies, how a person interacts with another person is as, or more, important than what a person does to or for another person. Breaches in respectful communication may be more offensive than a physical assault. Thus, positive and respectful communication skills are essential to cross-cultural understanding and acceptance. This may be as simple as looking at the patient and not at the interpreter when talking of matters of concern to the patient.⁴³ Directing questions to the interpreter or looking away from the patient can be interpreted as boredom or lack of caring on behalf of the nurse.

The field of humanitarian relief is fraught with ethical dilemmas of immense proportions and consequences. The ethical values and concerns of the numerous humanitarian agencies may vary substantially. Nurses working for these organizations to provide disaster relief must be cognizant of that organization's ethical values and practices, while maintaining a clear understanding of and firm commitment to the fundamental human rights of the individuals they are helping. Greater discussion of the ethical issues involved in humanitarian relief can be found in the Disaster Management Ethics section of the UN Disaster Management Training Program available at [www.reliefweb.int/rw/rwt.nsf/db900SID/LHON-69VEBY/\\$File/undp-ethics-1997.pdf](http://www.reliefweb.int/rw/rwt.nsf/db900SID/LHON-69VEBY/$File/undp-ethics-1997.pdf).

ENHANCING THE LIVES OF NURSES AND COMMUNITIES AFTER A DISASTER

Those who have survived a disaster in which many people close to them have died become transformed by their experiences in many ways, both positive and negative. Many are left with the guilt of having survived when so many others have perished; at the same time individuals have to deal with the grief of losing one's home, belongings, pets, and many irreplaceable items. Many connections to the past and to one's own identity are lost forever. Some people respond to these events by feeling angry toward those who either should have been able to prevent the disaster or who should have been able to respond more quickly in the immediate aftermath of the event. Family and friends may be blamed for being elsewhere when a person most needed support; the local community may become

the object of criticism because it was not caring enough quickly enough. Governments typically get blamed for not having adequate emergency assessment and warning systems in place to alert citizens to imminent dangers.

Many people experience various conflicting emotions as they strongly desire to return to normal, while recognizing that going back to the life that existed for them prior to the disaster is no longer possible. With the help of others, they need to build a different, new life that will accommodate great losses and still be one full of meaning and prospects for the future.

Nurses, as individuals and as professionals, must learn lessons from what has occurred. Rather than dispensing blame, they need to focus on the positive occurrences and consider how things could be done better in the future. They need to develop a good understanding of both the benefits and limitations of codes of ethics as tools for emergency decision-making. They need to take the opportunity to participate actively in the revision of codes of ethics and emergency procedures. They need to negotiate with and educate the members of their communities, many of whom are volunteers in disaster situations, on how to develop resilient communities that can best respond to the physical and ethical challenges of major disasters.

Nurses also need to take care of their mental and physical health in order to better serve those in need. This means that they need to learn to deal with issues of death and dying both from a personal perspective, and in disaster situations involving great losses of lives that heighten our senses of insecurity and vulnerability.

ALTHOUGH CULTURAL COMPETENCE is an essential component of any disaster response, disaster educational and training programs all too often use cultural stereotypes, and teach this important skill in an abstract manner. However, the program, "Assuring Cultural Competence in Disaster Response" was developed by the Florida Center for Public Health Preparedness at the University of South Florida in the United States for the purpose of: (1) preventing harm to the individual who the responder is attempting to help; (2) being more effective and efficient; and (3) protecting the responder from harm from an unintentional cultural blunder. This 1.5-hour course is free, and available online at www.fcphp.usf.edu/courses/search/search.asp.

CONCLUSION

The overwhelming needs accompanied by reduced available resources that occur during a disaster pose ethical challenges for which nurses must be prepared. Decision-making based on the ethical principles of autonomy, beneficence, non-maleficence, and justice, and the nurse's particular code of ethics

form the foundations for sound and ethical decision-making during a disaster. These skills must be learned and become part of the nurse's everyday armamentarium. They also must be practiced regularly in exercises and drills to ensure that the nurse is ready to meet the ethical challenges that occur during a disaster. Ethics must become an essential component of training in all phases of a disaster (planning, relief, and recovery), as well as in disaster research.

Nurses can be instrumental in fostering ethical values of caring and compassion by becoming active participants in establishing ethical standards and procedures. Nurses possess many skills, including the ability to truly listen, and the ability to help in many practical ways that will ensure the viability of communities struck by a disaster.

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CHAPTER 28

DISASTER RECOVERY

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IMMEDIATELY FOLLOWING a disaster-producing event, attention appropriately is focused on relief efforts to save lives, manage the acute needs of the victims, and prevent further injury and damage. This phase of a disaster may be short-lived, or may be prolonged, depending on the type and severity of the ensuing damage. The recovery phase of a disaster refers to that period of a disaster during which efforts are directed toward returning the affected society to its pre-event (and pre-disaster) state. Ideally, the recovery process begins soon after the event and overlaps with the relief phase. The aim is to return the affected community back to its “normal” state as quickly as possible. This means the restoration of commerce, the reopening of schools, and the reinstitution of usual community patterns. Some may refer to this as rehabilitation, i.e., the process of restoring things to their prior state; more commonly it is referred to as *disaster recovery*.

OBJECTIVES:

- Describe social capital and its role in community disaster recovery plans;
- Identify the important issues to consider in the healthcare recovery of a disaster-impacted community; and
- Define the essential roles of the nurse during the disaster recovery period.

Birnbaum describes the three response phases of a disaster as: (1) relief; (2) recovery; and (3) development.¹ The *relief phase* includes the immediate efforts to contain the loss of lives and prevent further deterioration; the *recovery phase* includes efforts to restore function to the “pre-event” status; and the *development phase* includes processes that strengthen the community beyond its pre-event state. Clearly, these phases are not separate, but rather overlap, with many interventions occurring simultaneously. For example, rebuilding a damaged healthcare facility in the community is part of recovery efforts to restore medical care functions in the community. However, rebuild-

ing the facility using seismic-resistant materials is part of developmental efforts to improve the community resilience against a future event.

Typically, disasters are associated with outpourings of humanitarian assistance from a world caught up in the confusion and alarm provoked by the event.² However, the immediate drama and high profile of the relief responses can absorb and exhaust compassion and support, leaving the ongoing recovery phase without the required critical attention and funding. Thus, long-term health and socioeconomic consequences are not reduced and may even result in a secondary disaster.

The link between disasters and level of development means that developing countries are most vulnerable to existing hazards.³⁻⁵ In fact, approximately 90% of disaster-related injuries and deaths occur in countries in which the annual per capita income level is <US\$760.⁶ These countries not only have more disasters, but also have less capacity to cope, even less capacity to plan and prepare,⁷⁻⁹ and shorter recovery times between disasters.¹⁰ This situation mandates that responses to disasters must be part of a wider development strategy.¹¹

Emergency/disaster responses may create a state of dependence among the beneficiaries, lack a sufficient developmental approach, and lack accountability.¹² To avoid damage to long-term sustainable health care in an affected community, resources must be delivered in a way that facilitates recovery and development and supports national and local health systems.^{3,13} Community members must be involved throughout all of the response periods, including the recovery phase. The involvement of the community in planning, building inherent capacity, and engendering key local support is essential to successful recovery. Frequently, international agencies overlook local capacities, particularly in the early stages of assistance, resulting in marginalisation and alienation of existing local capacities.¹⁴

Social capital refers to social structures and social networks with their inherent resources that can be mobilized to achieve mutual goals.¹⁵ In terms of a community, this describes the social norms as well as the networks of individuals and groups that affect the social and economic components of the community.¹⁶ Increasing bodies of work point to the importance of social capital in disaster preparedness, relief responses, recovery plans and responses, and development.¹⁵⁻¹⁸ In fact, recovery efforts that do not incorporate the social capital of the community are likely to be less than successful, be met with open resistance, be more costly in terms of time and resources, and ultimately may fail.

Viewing social systems as active resources during a disaster casts a different light on victims, as it emphasizes human capability rather than vulnerability. Accentuating the positive aspects of a community's social structures, instead of focusing on the destruction of material capital, has been shown to enhance sustainability in both recovery and developmental programs.¹⁶

PRINCIPLES OF RECOVERY MANAGEMENT

All responses — whether in mitigation, relief, or recovery — must address specific needs, involve members of the affected community, be locally coordinated, and be sensitive to the cultural and social needs of the particular community. This awareness and sensitivity impact on the ability to integrate outside responses with local organizations.^{19,20} In addition, all recovery interventions should include accountability, flexibility, adaptability, and responsiveness.²¹

The requirement for external assistance during a disaster does not equate to “any kind of assistance and send it immediately.”²² According to the World Health Organization (WHO), “a hasty response that is not based on familiarity with local conditions and meant to complement national efforts only contributes to the chaos. It is better to wait until genuine needs have been assessed and to accept that international intervention can raise artificial expectations at an extraordinary cost to the local provision.”²² This mandates that all assistance be highly focused based on strict prioritization of tasks as deemed necessary by an appropriate needs assessments.^{7,23–26} The quality and success of any aid response is best measured by the extent to which aid activities overlap the needs of affected populations.

Integration with local communities, government, and societal services is a core principle of international development and humanitarian aid.^{10,27} Responding international organizations must consider how their efforts contribute to ongoing local and national systems and processes that drive the recovery plan. It is the host nation (or community) that should have the lead, and responding agencies’ activities should be coordinated by this local, central authority.²⁶ This approach also helps to enhance local capacity building, and empowers community members to regain control over their lives. Failure to do this can lead to mistrust, resentment, and a lack of cooperation, as well as undermine the capacity of local people to solve their own problems.^{13,28}

LOCAL CAPACITIES AND HUMANITARIAN STANDARDS

Most established aid agencies subscribe to standards and codes that include respect for, involvement of, and investment in local capacities. The Red Cross Code of Conduct, Principle 6 states “We shall attempt to build disaster response on local capacities... All people and communities — even in disaster — possess capacities as well as vulnerabilities. Where possible, we will strengthen these capacities by employing local staff, purchasing local materials and trading with local companies.”⁴⁴

The Sphere Project states “Disaster-affected populations must not be seen as helpless victims, and this includes members of vulnerable groups. They possess, and acquire skills and capacities and have structures to cope with and respond to a disaster situation that need to be recognized and supported.”⁴³

Chaos and confusion result when multiple independent organizations are involved in any response, especially in the presence of language, cultural, and standards differences. Certainly, inter-agency coordination has been a challenge in past responses with unclear functions, and the absence of any single agency taking charge.^{12,29–31} This was notable in Banda Aceh, Indonesia, where the >400 relief organizations and international agencies present in that region five weeks after the tsunami resulted in uncoordinated, massive duplication of relief efforts, and redundancy in humanitarian assistance.³² Additionally, this excess nearly stopped logistical relief efforts in other parts of Indonesia by blocking airlift movement at one Banda Aceh airport.²⁶

Cooperation and coordination are vital for effective humanitarian aid operations.^{2,33–36} Ideally, the local community should implement a coordination centre for all international relief agencies and interventions.^{37,38}

A great increase in government donations occurred from 1980–1994 in response to humanitarian needs and the emergence of aid as a political tool.³⁹ The US Surgeon General, Richard Carmona, described this as “health diplomacy”.⁴⁰ Indeed, research has shown that the proportion of Indonesians that viewed the United States favourably increased from 13% in 2003 to 38% in 2005 following the tsunami assistance program.⁴¹ However, while donors demand some type of value for their money, all too often aid efforts have proven to be ineffective.^{39,42} The Sphere Project provides intergovernmental organizations with an overall coordinating framework for international and local disaster relief through the use of explicit standards of practice.⁴³ However, actual practices remain variable and recognized minimum standards for such coordination do not exist.

ISSUES IN RECOVERY

Effective management of the recovery phase is based on a detailed understanding of the many issues that may be confronted in attempting to restore a community. Some of these issues include: (1) the economic impact; (2) shelter; (3) the restoration of local services; (4) communication; (5) equity and fair treatment; (6) donations; and (7) the management of volunteers.

Economic Impact

Restoring a sense of economic security to a damaged and dysfunctional community is critical to its recovery. At the macro level, this involves rebuilding through local employment and private sector initiatives, with the assistance of external organizations. At the micro level, compensation from government funds, insurance companies, or donations can reduce the initial sense of loss.

Local community functionality requires that recovery management involve local providers, rather than having outside agencies impose their preconceived solutions on an already traumatised community.⁴⁵ International aid can

be detrimental to a society if local workers with expertise valuable to recovery efforts are hired away by international aid organizations in need of staff, and if goods and services are duplicated.^{13,46} Failure to include members of the local community in recovery plans and interventions undermines local capacity.⁴⁷

International aid systems and structures must be flexible and responsive to the changing community needs and resources. Additionally, international personnel assisting in recovery management must possess a thorough understanding of the types of interventions that might be sustainable with respect to livelihoods, market relations, community development, and environmental resource management. Both sustainability and development require a vision of the future and an organization with leadership capable of guiding interventions to attain them.

The following statement, directed toward the Southeast Asia tsunami, is applicable to the needed focus in recovery from all disasters:

The restoration of livelihoods presents a major hurdle for long-term recovery. Many of the devastated communities already had high levels of poverty... The reconstruction of communities and the maintenance of civil society hinge on people's regaining their ability to work and generate income — a complex and poorly understood dynamic that will take years to play out and that will be affected by the psychological distress of the survivors.⁴⁸

Shelter

The loss of homes is a tragic consequence of many disasters, particularly those caused by natural events. Adequate housing is an essential human right and includes the right to live somewhere in security, peace, and dignity.⁴⁹ Providing emergency, temporary shelter immediately following an event may not address all of these components, but sheltering interventions in the recovery phase must include these considerations. According to Ian Davis, "shelter must be considered as a process, not as an object".⁵⁰ The aims of shelter-related interventions should include attempting to meet the impacted population's needs for: (1) health, including protection from environmental issues; (2) privacy and dignity; (3) physical and psychological security; and (4) support of livelihoods.⁵⁰ This cannot be accomplished without active participation of the population in reconstruction plans and efforts, as well as thoughtful environmental impact assessments. In addition, housing efforts must incorporate mitigation measures to decrease the community's vulnerability to future events. Ideally, recovery reconstruction and developmental planning would include efforts to address those pre-existing social inequalities (e.g., environmental, socioeconomic, age- or gender-based) that increased the community's vulnerability prior to the event.

In reviewing both transitional and non-transitional shelter issues in Aceh and Sri Lanka following the Southeast Asia tsunami in 2004, Kennedy *et al* summarize the following lessons that were learned:⁵¹

1. Community participation in decision-making for shelters should include representative ages, genders, and ethnicities from among those who will live in them;
2. Environmental considerations, including long-term impacts on ecosystems and environmentally dependent livelihoods, should be considered in shelter design and construction;
3. Coordination among organizations is essential to ensure fairness, uniformity, and consistency in meeting local and national codes as well as international standards;
4. Reconstruction plans and implementation should include measures to enhance the long-term capacity of local partners to avoid rebuilding that includes previous or other vulnerabilities;
5. Shelter should support sustainable livelihoods;
6. Policy-making and advocacy should be undertaken to ensure land rights, including tenure and security, are in place and equitable; and
7. Trained and experienced staff are necessary to connect transitional settlement/shelter with permanent housing.⁵¹

Restoration of Local Services

Extended periods without local services not only contribute to the impact of the disaster on individuals and the community, but also may encourage a reliance on external assistance and services. Local medical services, as well as other public services, should be restored as soon as possible during any disaster situation, even if this process seems to consume large amounts of resources. Even inconvenient access to services is better than a complete lack of services. Certainly, the loss of local medical services in the city of New Orleans following Hurricane Katrina had an overwhelming effect on the city's ability to recover.

Restoring educational and other community services as soon as practicable is essential to avoid isolation and mitigate secondary impacts of a disaster. For both individuals and communities, the therapeutic process is enhanced by the re-establishment of habitual behaviors. Getting children back to school helps restore social cohesion for all members of the family, not just the children; it provides time for parents to rebuild their lives and their economy. The restoration of the education of children often impacts the availability of the local workforce and, thus, can be critical to the restoration of health and community services.

While the government of the affected country has a major role to play in the organization, delivery, and funding of recovery support, it cannot bear the

entire burden. Economic support also must be provided by the private sector with the aim of minimizing long-term harm and facilitating the economic functionality of the community. Thus, restoring the private sector is critical to community recovery and development. The creation of partnerships between the public and private sector is key to effective recovery management.

Communication

Communication and information management remain some of the most consistent challenges and problems in disaster management.^{5,52–56} Information is power, and valid information is critical to enable decision-making and resource prioritization.⁵⁷ Members of an affected community must have easy access to reliable information regarding safety issues, available services, entitlements, and opportunities. The quality of disaster management may depend on the quality of communication and information provided to the victims as well as to response actors.⁵⁸

Much of the management of the recovery phase of a disaster is related to facilitating the provision of, and access to, the restored or replaced societal services. In a study of flood victims in Iowa in the United States, Stimpson *et al* found that only a small proportion of people actually accessed available recovery services.⁵⁹ This highlights the need for recovery efforts to focus on reducing barriers to the accessibility of services. Consideration must be given to possible communication barriers, transportation issues, and to creating and expanding partnerships with community organizations to limit the burden and improve the outcomes for disaster victims.⁶⁰

Equity and Fair Treatment

All recovery efforts must aim to ensure equity and fair treatment. Community leaders should promote these values and discourage bureaucracy, to the degree possible. Following the Southeast Asia tsunami, there were claims by some affected people that the non-governmental organizations dealt only with village officials, thereby benefiting the articulate, while marginalizing women and the poor.⁴⁷ Existing inequalities may be unintentionally exacerbated by international response interventions. Care must be exercised to ensure that interventions do not strengthen particular groups of citizens (e.g., the more affluent, the more articulate, the more experienced in accessing bureaucratic aid) while overlooking those groups of citizens less able to self-advocate.¹⁴

Soon after the tsunami struck Sri Lanka, the government created “conservation” buffer zones along the coast, wherein people were not allowed to rebuild their lost houses. However, new multinational hotels were built in some of these restricted areas, while tens of thousands of local residents were

denied such an opportunity to restore their homes and their lives.⁶¹ Such inequities and lack of transparency contribute to mistrust of local/national leadership and thwart overall recovery.

In the recovery phase of a disaster, there may be a need for specific organizations or services to assure the needs of vulnerable populations. Housing needs, medical care, and security for vulnerable groups are just a few of the issues that must be addressed for all vulnerable populations. (See Chapter 16.)

Donations

The sad truth regarding donations during a disaster is that often they are in response to media coverage, political interests, and/or the profile and power of aid agencies, rather than actual needs. Dramatic, sudden-onset events with extensive damage and sensational photographic images stimulate more donations than do slow-onset events, such as famine or drought. Thus, the recovery phase of a disaster, which is a long-term process that continues long after the relief teams and media have left, remains consistently under-funded.

While donations can impact the local economy, the application and relevance of donations will determine whether they are helpful or useless, or even a hindrance. Assistance always must be directed to meeting some defined needs or it has little value for, or may be detrimental to, the affected population.³⁰ This requires that local authorities provide potential aid agencies with the actual needs of the affected community.⁶² Money is usually the most appropriate donation as it enables the response organization to purchase exactly what is necessary and helps restore the local economy. However, excessive donations may have negative consequences, as was observed following the Southeast Asia tsunami; heavily funded organizations lacked incentives to coordinate with other organizations and, in fact, created a competitive atmosphere among various response agencies.⁶³ Resource-rich international organizations may have institutional or organizational imperatives to visibly spend money in ways that can undermine local and national capacities. Smillie and

GOOD HUMANITARIAN DONORSHIP

The objectives of humanitarian action are to save lives, alleviate suffering and maintain human dignity during and in the aftermath of man-made crises and natural disasters, as well as to prevent and strengthen preparedness for the occurrence of such situations ... Donors will provide humanitarian assistance in ways that are supportive of recovery and long-term development ... [and] sustainable livelihoods and transitions from humanitarian relief to recovery and development activities ... [Donors will help strengthen] the capacity of affected countries and local communities to prevent, prepare for, mitigate and respond to humanitarian crises.⁶⁵

Miner concluded that “[h]umanitarian principles are not the main driver of donor behavior in financing humanitarian work”.⁶⁴

The establishment of Good Humanitarian Donorship has been developed to guide donor agencies in the decisions they make about human needs in times of crisis.⁶⁵

Management of Volunteers

Historically, during a disaster, there is a natural outpouring of unorganised or ‘short term’ volunteers willing to provide medical assistance.^{66,67} Although disaster relief personnel should respond only when invited, unsolicited volunteers and aid are inevitable and must be both anticipated and managed in all phases of a disaster.⁵³ Volunteers who operate outside of “Command and Control” may rapidly exacerbate the problems rather than alleviate them.^{5,10,30,37,53,66,68–70} Medical assistance may be in a highly organised form provided by governmental organizations and NGOs, or it may be in the form of individual volunteers who require specialized management.⁷¹ This may require experts in a number of fields to manage and support multiple and diverse functions, including issues of selection, self-sufficiency, liaison, and coordination.⁷¹

Unrequested volunteer responses to disasters persist, along with the myth that the “affected local population is helplessly waiting for the western world to save it”, a view often perpetuated by press coverage.²² However, western response teams are not necessarily the best equipped to deal with local conditions. In addition, foreign assistance may be in response to public opinion and pressure with little consideration of how productive that assistance will be.

HEALTHCARE SYSTEMS RECOVERY

In addition to the possibility of direct damage from an event, healthcare facilities are vulnerable to indirect damage because their functionality is dependent on the other basic societal functional systems such as water and sanitation, transportation, communication, and security. Restoring dysfunctional or destroyed healthcare systems likely involves restoring essential infrastructure within the community, but its restoration is critical to the physical and mental health recovery of the population, and is a necessary component of the economic functioning of the community. In many cities, the healthcare system is one of the community’s largest private employers. As reported in the *New York Times*:

Of all the factors blocking the economic revival of New Orleans, the shattered healthcare system may be the most important — and perhaps the most intractable.⁷²

While many of the issues confronted during the recovery phase are varied and dependent on the nature of the community and the nature of the event,

there are some consistent themes that are important to consider in terms of healthcare recovery. These include:

- The restoration and maintenance of health services;
- Disease prevention and control;
- Risk communication and public education; and
- Coordination of response and capital recovery activities.

Restoration and Maintenance of Health Services

Healthcare services may be significantly affected by disasters. The impact may be direct through damage to or destruction of the health infrastructure, or indirect through loss of essential resources, including healthcare workers, medical supplies, and equipment. At the same time, the impact of the event creates an enhanced demand for services to care for the victims of the event. The loss of key personnel is a significant impediment to business continuity within the healthcare system. The Southeast Asia tsunami, for example, killed many healthcare workers in an area that already was undersupplied, thus impeding the ability of the health system to restore functionality. Those healthcare workers who remained were suffering the same consequences as the remainder of the community, including dealing with personal loss and grief. In some events, particularly pandemics, health workers become especially vulnerable, and there may be reluctance on the part of the healthcare workers to place themselves and their families at risk. Damage to community infrastructure, such as the transportation system and roads, may restrict the ability of both staff and patients to access healthcare facilities. The risk profile of patients with injuries as a direct consequence of the event, and patients with chronic illness and injuries who are unable to access normal medical care and drugs suggests that they are particularly vulnerable to secondary injury during the recovery period.

In addition, drugs and other supplies may be lost and the supply chain itself may be disrupted. With just-in-time logistics, most health facilities carry relatively small stocks and, thus, are unable to maintain services even in the absence of direct damage. Restoration of the supply chain for consumables and equipment is necessary for effective functioning of the healthcare system.

The arrival of external health services to assist a damaged healthcare system can change the expectations of the community. This is particularly true when external assistance is provided from countries with highly developed healthcare systems providing assistance to resource-poor countries. The quality of care provided by these teams likely will be unable to be sustained once the teams have returned home and ongoing health care returns to “normal”. The expectations of the community may be raised to an impossibly high level and may create dependency issues.^{46,73} Therefore, practices such as the use of advanced surgical techniques and drugs that cannot be afforded once the visitors leave can result in secondary damage to the community. However, if healthcare issues are addressed

through an integrated, primary healthcare approach, the local healthcare system can be preserved and even strengthened by outside assistance.³ In the aftermath of the Southeast Asia tsunami, there were numerous, unfortunate examples of well-intentioned, but misguided, attempts by some international medical teams to take over the local health system or provide services, such as trauma surgery, that were not needed, which placed additional strain on Ministry of Health staff.²⁷

The restoration of healthcare services requires the rapid restoration of a functional health system to reduce ongoing damage. Involvement of local staff, wherever possible, and the re-establishment of local personnel in their own healthcare facilities, are vital to the sustainability of services and community cohesiveness.⁷⁴ Consideration also must be given to the incorporation and control of external health resources that respond as part of an international collaborative effort to ensure that these complement, rather than replace, local systems. Clinical standards and guidelines must be clear and relate to the local community's expectations and capabilities.

Disease Prevention and Control

Population, as well as individual, health measures must be restored quickly to ensure ongoing health and safety. Environmental health measures, such as the ongoing availability of clean food and water, are absolutely essential and must be the immediate concern. Disease monitoring and control should be restored as soon as possible, and vector control measures must be addressed if relevant to the area and the environmental conditions.

Risk Communication and Public Education

Communication regarding potential and actual health risks along with education regarding ways to reduce risks are important to ensure that public health standards are maintained. Mechanisms of public education, particularly those related to infection control, must be diverse and accessible to all members of the community. Keeping the public informed is a critical element to ensuring community trust and a sense of local control and engagement.

Rebuilding the Healthcare Infrastructure

The loss of healthcare services and infrastructure is devastating to a community and recovery success hinges on the ability to restore these services as quickly as possible. Rebuilding both primary and secondary healthcare infrastructure is a critical component of the recovery phase. Relocating services to preserved buildings or to temporary structures may be necessary. Temporary facilities (field hospitals) may be necessary for the short- to medium-term period, but the building of permanent structures must be a high priority. The controversy

over the use and efficiency of foreign field hospitals (FFH) in disaster management resulted in the WHO/Pan American Health Organization (PAHO) convening a meeting of experts to review guidelines regarding the dispatch or donation of FFHs to disaster zones, particularly in developing countries.⁷⁵ According to the WHO, FFHs should be deployed: (1) only following an appropriate declaration of an emergency and a request from the health authorities of the affected country; (2) when they are integrated into the local health system; and (3) when the respective roles and responsibilities for their installation and operational sustainment have been defined clearly. The three distinct purposes for FFHs defined by the WHO/PAHO include:

1. *Early emergency care* — to provide early emergency medical care, including Advanced Trauma Life Support (ATLS). This period only lasts up to 48 hours following the onset of an event;
2. *Follow-up trauma and medical care* — to provide follow-up care for trauma cases, emergencies, routine health care, and routine emergencies during the period when health services are progressively overwhelmed by the need for ongoing secondary care of trauma victims and routine medical care. The healthcare facilities may not be fully operational and local staff may urgently need time to rest and tend to possible personal losses. The primary role of the field hospital is to temporarily fill the gaps in emergency medical assistance; this period should not exceed 15 days; and
3. *Temporary health facility* — to substitute for damaged installations pending final repair or reconstruction, usually from the second month to two or more years. Temporary facilities are the only FFHs applicable to the recovery phase of a disaster.

Restoration of Community Functioning

The recovery phase of disaster management requires integrated planning with long timeframes and the development of linkages among various international agencies. The means by which recovery of the community will be accomplished is best addressed in formal recovery plans, including: (1) necessary legal and legislative issues; and (2) organizational roles and responsibilities.

To facilitate the recovery phase, legislation, rules, and regulations should be in place to ensure that there is the authority required to support the actions needed to manage recovery. Without the necessary authority, work cannot be accomplished, and the best of intentions will go unmet. Confusion regarding regulations can impede recovery efforts and foster mistrust among the community.

In addition, recovery plans should ensure that there are formal systems/structures in place to direct the management of the recovery process. Such

structures, which should include some form of Recovery Committee, are essential to achieving clarity of roles and responsibilities between various recovery agencies, and to facilitate cooperation and coordination. The development of relationships with various international agencies is helpful in executing the recovery plan and facilitating recovery activities.

NURSING ROLES IN RECOVERY

Nurses, as the majority of the healthcare workforce, are critical to the recovery of the healthcare system during a disaster. Recovery is a multidisciplinary task and, therefore, a collaborative and coordinated approach is essential. Conditions during a disaster mandate that practice restrictions be altered. While it is not the time to learn to be a neurosurgeon, it is a time when flexibility about who does what and when is paramount. Task-sharing, in which more experienced healthcare providers teach certain healthcare skills to less experienced (or even inexperienced) workers and oversee their activities, are essential in all the phases of disaster health care. Nurses must be prepared to assume this role of leadership in assuring a prepared disaster healthcare workforce.

Nurses also have an essential role as patient advocates during the disaster recovery phase, particularly for vulnerable groups. Building resilience amongst nurses is critical to their survival in major incidents and disasters. This can be done by providing: (1) appropriate training and preparation; (2) interest and support; (3) the needs of the caregivers; and (4) debriefing and mental health support. For example, when Cyclone Tracy struck Darwin, Australia, the families of the key response workers were evacuated early to ensure that these workers would not be distracted from community support tasks by family care needs. While this may be seen by some as discriminatory, it is practical and results in improved outcomes for the community. Nurses are highly regarded within the community and do have a critical and influential role to play in restoring community confidence and morale.

CONCLUSION

A disaster causes damage and dysfunction to a number of basic societal functions, including medical care, that must be restored in order for the community to fully recover. Many times, the assistance of national and international organizations is necessary to accomplish such recovery. Even so, the process is a long-term endeavor that may take several years. Along with recovery efforts, interventions aimed at increasing the community's resilience to future events can contribute to the development of disaster response capacities, improve resilience, and reduce community vulnerability. Careful planning and management of this phase of the disaster response can mitigate the long-term impact

of the event, and aid considerably in restoring community morale and functionality. Special attention must be paid to providing quality, equitable, culturally-appropriate aid that aims to meet a defined need. Aid agencies must respond to defined needs of the impacted community and must be accountable to the affected population.

THE ROLE OF A SCHOOL OF NURSING IN THE PROVISION AND COORDINATION OF HEALTHCARE SERVICES TO HURRICANE KATRINA EVACUEES

In September 2005, the Southern University School of Nursing in Baton Rouge, Louisiana, made plans to “adopt” a Federal Emergency Management Agency (FEMA) transitional trailer village, which was home to >1,500 Hurricane Katrina evacuees. The plan included a strategy to provide easy access to primary health care for the evacuees by utilizing an existing infrastructure of the School of Nursing’s academic, nurse-managed center, which consisted of both a mobile and a stationary clinic. Both clinics were used to provide primary healthcare services to rural and inner-city, under-served populations.

Primary healthcare services offered to the evacuees included assessment, diagnosis, treatment, and management of common acute and chronic illnesses. Hypertension and Type 2 diabetes mellitus were among the most common presenting conditions. In addition to on-going treatment and monitoring of these conditions, clients received prescriptions, nutrition and health teaching (emphasizing self-care practices in the management of chronic health conditions), and community-based referrals, as needed. Medicaid enrollment services, the Women, Infant, and Children Program (which is a federally funded nutritional program that serves low-income pregnant, postpartum, and breast-feeding women, and infants and children up to age 5 years who are at nutritional risk), childhood and adult immunizations, and family planning also were among the services available to eligible evacuees. Primary healthcare services were provided to evacuees twice weekly at the FEMA trailer site for almost two years. Prior to withdrawing services, the mobile clinic staff worked with evacuees and other healthcare providers to transition evacuees to more permanent, community-based healthcare services.

Wanda Spurlock

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CHAPTER 29

THE SOUTHEAST ASIA TSUNAMI: HEALTH ASPECTS

Elaine Daily

ON 26 DECEMBER 2004, one of the largest earthquakes within recent history occurred in the Indian Ocean, along the Sumatra-Andaman fault off the west coast of northern Sumatra. The changes in the earth as a result of this large quake displaced vast volumes of water and generated the worst tsunami ever recorded. Although reported wave heights varied between 2.5 to 30 meters (8–100 feet) depending on the area's directional location relative to the quake, and the surrounding water depth, in general, wave heights were closer to 10 meters (33 feet).¹ The energy from the tsunami thrust seawater approximately 500 meters to 5 kilometers inland, forcefully moving and/or obliterating any structures or persons encountered. In some areas, particularly along the west coast of Sumatra, almost all above-ground infrastructure was sucked into the ocean by the tsunami leaving enormous amounts of debris along the shoreline. Although these combined events affected 11 countries within the Southeast Asia region, the greatest devastations occurred in Thailand, Sri Lanka, Indonesia, India, and the Maldives.

OBJECTIVES:

- To describe the initial medical health issues of the earthquake/tsunami victims;
- To describe the initial public health concerns following the events; and
- To identify primary challenges to relief efforts to affected populations.

In Indonesia, the country nearest to the epicenter, only minutes transpired between the earthquake and the tsunami. However, for most of the other countries affected, several hours transpired between the earthquake and the tsunami. Despite this, the population living along the Indian Ocean received no official warning regarding the tsunami. Signs, such as a temporary receding of the seawaters, were observed in a few coastal areas. However, this

sign prompted varied responses among the population; some sought safety on higher ground, while others were drawn to the beach to witness this unusual occurrence and collect fish and other sea deposits.

BASELINE HEALTHCARE INFRASTRUCTURE AND SERVICES

The healthcare systems in the five countries most affected by the earthquake and tsunami consisted primarily of public facilities. Tertiary care was provided at urban, provincial, teaching, and military hospitals. Secondary care was provided at regional and provincial facilities; and primary health care was provided at community health centers as well as at all other healthcare facilities.

Table 29.1 provides baseline information on the number of healthcare personnel in Thailand, Sri Lanka, Indonesia, India, and the Maldives prior to the events of 26 December. The differences in health provider capability among the countries are marked and reflective of each country's level of healthcare development and potential surge capacity. Of note is the paucity of physicians that existed in Indonesia and Thailand compared to the Maldives, India, and Sri Lanka. However, among the five countries, Thailand had the second highest number of nurses/population (15.3/10,000), while Indonesia had the lowest ratio of nurses/population (6.5/10,000).² The ratios of nurses and physicians/unit population were greatest in the Maldives where healthcare is provided predominantly by transient healthcare personnel from other countries.

	THAILAND	SRI LANKA	INDONESIA	INDIA	MALDIVES
Nurses per 10,000 population	15.3	8.9	6.5	8.0	27.0
Physicians per 10,000 population	3.0	5.0	1.1	5.9	9.2
Hospital beds per 100,000 population	21.3	31.0	6.2	1.3	18.6

Table 29.1: Pre-event healthcare providers and available hospital beds in five countries affected by the earthquake and tsunami²

IMPACT OF THE EARTHQUAKE AND TSUNAMI

The impact of the combined earthquake and tsunami varied by geographical location and population density. Certainly, Indonesia as well as areas along the coastline near the epicenter were impacted most severely (Figure 29.1). The devastations that occurred as a result of the earthquake and tsunami resulted in substantial environmental destruction. Massive debris, including train cars, vehicles, fuel tankers, buildings, household materials, and even whole trees littered the coastline.

In addition to environmental devastation, the events resulted in a total of 224,983 deaths, 422,750 injured, and an estimated 1.2 million displaced persons.³ However, these numbers are not precise, as reporting was not consistent, and some injured may not have been accounted, or may have been reported more than once if they sought care from more than one of the relief agencies. Table 29.2 lists the reported numbers of fatalities/missing and injured persons by country and demonstrates the heavy losses suffered in Indonesia, in which the greatest losses and damage occurred in the province of Aceh where the population density was very high. Table 29.2 also provides data on the number of persons injured per 10,000 population in each of the countries, demonstrating the high burden of injury experienced by the Maldives and Sri Lanka. Although the Aceh Province of Indonesia was most severely affected, the populations of the islands suffered the greatest as providing assistance to them was logistically most difficult.

Overall, children accounted for approximately one-third of the mortality, and nearly four times as many women than men died.⁴ This may have been due to the fact that the women and children were at home at the time of the tsunami, whereas men may have been out fishing or working in higher locations. Most fatalities occurred on the day of the events. As December is the peak of the tourist season, especially in Thailand, where tourist resorts are located on its beaches, non-Thai persons represented a large proportion of the dead and injured.

The primary causes of death were drowning and trauma from forceful contact with stationary objects and debris in the water. Injuries sustained by the victims mainly included lacerations, fractures, and aspiration/near drowning, with small numbers of head, abdominal, and chest trauma.^{5,6} Often, the lacerations were deep and contaminated with numerous different enteric organisms. Even at a very early stage, the wounds of many victims were suppurative.⁵

The infrastructure in the areas impacted by the tsunami was extensively damaged. Buildings were destroyed, bridges collapsed, some roads were blocked, and enormous quantities of debris were deposited both on land and

	THAILAND	SRI LANKA	INDONESIA	INDIA	MALDIVES	TOTAL
Number dead/ missing (% of total)	8,327 (3.7)	36,603 (16.3)	167,540 (74.5)	12,405 (5.5)	108 (0.04)	224,982 (100.04)
Number injured (% of total)	16,784 (4.0)	59,662 (14.1)	328,805 (77.1)	19,592 (4.6)	907 (0.2)	422,750 (100)
Number injured/ 10,000 population	1.304	11.940	6.540	0.068	26.333	1.534

Table 29.2: The number of persons reported dead/missing and injured per country and the number injured per 10,000 population in each country³

in the sea. Some debris included hazardous and medical waste materials (Figure 29.2). Water systems were destroyed or contaminated, and sewage systems were damaged. The impact initially destroyed much of the communication and transport infrastructure in the most severely affected regions. Road transportation infrastructure along the north and west coasts was destroyed; many communities could be reached only by foot, boat, or air.

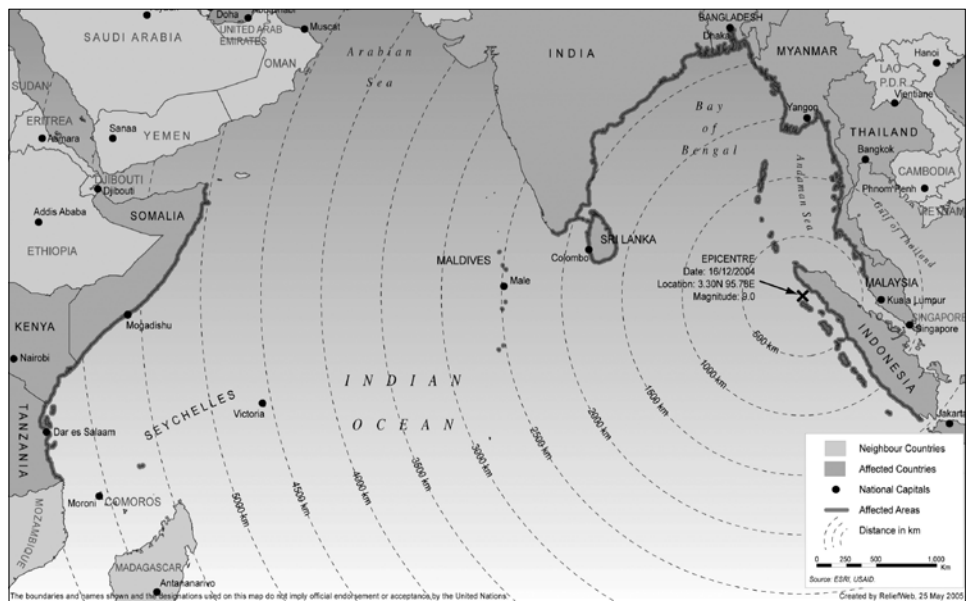


Figure 29.1: Tsunami-affected regions in Southeast Asia

Hundreds of healthcare facilities, personnel, and supplies were damaged or destroyed in the affected countries. The greatest amount of damage to healthcare facilities occurred in Indonesia; the main tertiary care hospital and three smaller hospitals in Banda Aceh were severely damaged. Facilities that stored medical supplies, drugs, and equipment also were damaged or destroyed. Even facilities that were not destroyed faced difficulties in functioning due to loss of electrical power; clean, potable water; refrigeration; and staff.

Many healthcare providers were injured and killed by the tsunami, and many were unable to report to work as they were searching for or caring for family members. For example, in the city of Meulaboh, in the Aceh Bara Province of Indonesia, the coastal military hospital was completely destroyed, leaving only one intact, albeit damaged, hospital to serve a population of several hundred thousand. However, only four of 14 doctors, and 18 of 120 nurses reported to work following the tsunami.⁷ Similarly, during the first five days following the tsunami, only 25% of healthcare staff reported to work in a hospital that remained functional in Sri Lanka.⁸

EMERGENCY AND PUBLIC HEALTH CONSIDERATIONS

Immediate emergency considerations focused on rescuing and treating as many injured victims as possible. Unfortunately, these needs were accompanied by a dramatic reduction in resources available. Clearly, some countries were better prepared to handle mass casualties than were other countries. Thailand, for example, had a mass-casualty plan, which was activated immediately upon notification of the tsunami. In addition, the plan had been practiced in exercises conducted just two weeks before the events.⁹ Within hours of the events, hospitals in non-damaged areas of Thailand sent healthcare teams to affected areas to provide on-site care and triage. This relieved much of the chaos and pressure at the receiving hospitals in Thailand. The Thai government also was almost immediately able to mobilize 50,000 rescue workers to search for survivors.

In contrast, some areas of Indonesia were completely cut off from assistance other than that which could be provided by the surviving local population. Even two weeks after the tsunami, many victims had untreated injuries.¹⁰ For the most part, those hospitals that remained functional in the other affected countries were overwhelmed by victims, the dead, families, and persons seeking information about missing family members. Overcrowding impaired the ability to perform triage adequately and the scarcity of supplies as well as staff limited appropriate treatment of the victims.

The two main injuries that required the greatest medical attention were aspiration (near drowning) and trauma, primarily injuries from foreign bodies, including rock, wood, concrete, and metal. Many wounds were impacted with soil and sand. Assessment of aspiration in victims included their clinical history, their degree of dyspnea, and oxygen saturation levels via pulse oximetry, if available. Treatment consisted of supplemental oxygen, as indicated, and intubation and mechanical ventilation for patients in severe distress. However, in many instances, ventilators were not available and victims succumbed. Because of the vast amount of contaminants in the water, patients were treated with antibiotics, if available. A 358-bed hospital in Ampara, Sri Lanka, admitted 927 victims of the tsunami on 26 December.¹¹

Wound care comprised the majority of care to victims of trauma following the tsunami. Superficial wounds were cleaned; deep wounds were cleaned and debrided. Many wounds rapidly became infected and foul-smelling. Amputations frequently had to be performed because of severe infections, gangrene, and extensive injury.

Public health concerns primarily included contaminated water and food supplies, and lack of shelter. Initially, there were grave concerns regarding infectious diseases as well as water- and insect-transmitted diseases. Providing water, sanitation, food, shelter, and necessary medical care to the displaced population were the main public health concerns, at least during the early

period after the events.¹² Certainly, environmental health concerns were a high priority. In some areas where pre-tsunami vaccination coverage was low, mass measles vaccination programs were initiated.



Photo courtesy of Yuichi Nishimura, Hokkaido University

Figure 29.2: The tsunami of 26 December 2004 destroyed the city of Banda Aceh, Indonesia, leaving only a few structures standing.

The destruction of homes left hundreds of thousands of people immediately homeless. Many victims sought shelter in available public buildings, such as schools, government buildings, and mosques. Makeshift shelters were created by many individuals, and temporary housing was set up in campsites by the governments and other organizations. Because of remaining standing water as well as damaged water and sanitation systems, public health officials were concerned about the risks of water-borne diseases, such as cholera, other epidemic forms of diarrhea, and typhoid.¹³

The enormous numbers of dead bodies posed numerous problems to the damaged and already challenged healthcare facilities and staff. In most areas, dead bodies were brought to the hospitals, as was the usual practice. However, after >100 dead bodies had arrived at the Ban Nam Khem Hospital in Thailand, the government approved the use of nearby temples to temporarily store the bodies and allow forensic identification.⁹ The hot and humid weather in the region contributed to the rapid decomposition of bodies, which hampered victim identification, caused a severe stench, and, in many places, led to inappropriate attention and actions, such as mass burials.

The psychological suffering of the victims of the earthquake and tsunami was, and likely still is, enormous. It is difficult to imagine the fear, confusion and desperation of survivors, especially the children, who witnessed the sud-

den, violent death of close relatives, and saw enormous waves wash away their worlds. Almost all survivors were touched personally by the death of someone close to them. Personal near-death experiences and fear of the unknown compounded their grief and anxiety, placing victims at high risk of developing post-traumatic stress disorder (PTSD), depression, or a range of other social and emotional difficulties. In addition to the grief experienced over the loss of family and loved ones, survivors experienced a sense of guilt regarding their own survival.

Certainly, the manner in which the dead were handled in many countries contributed to the stress and mental anguish of the surviving victims. Many of the traditional beliefs and customs regarding care of the dead were violated, denying many survivors any sense of closure.

Approximately 20,000 children were directly affected by the events. One study of 371 children 7 to 14 years of age evaluated two months after the events found that children from affected villages were more than twice as likely to exhibit symptoms of PTSD compared to children from unaffected villages. In a follow-up study nine months after the tsunami, the rates of these symptoms, although less, had not decreased significantly.¹⁴

Shortly after the tsunami, the World Health Organization (WHO) worked with the national governments to increase disease surveillance to detect disease outbreaks among the affected populations.

RESPONSES

Local Responses

In general, all early relief responses were provided by the local people. Initially, as in most such events, search and rescue efforts were conducted by surviving members of the community. As previously mentioned, citizens brought both the injured and the dead victims to those healthcare facilities that remained functional. Local volunteers also assisted with the burial of the bodies.

Primary healthcare relief was supplied by local volunteer medical personnel. Many healthcare staff worked for 24-hour periods during the first days following the events. In Thailand, some healthcare providers from a severely damaged hospital set up alternative treatment sites in a nearby hotel.¹⁵ However, lacking appropriate equipment, they could provide only limited care.

Volunteers from local foundations as well as the International Red Cross and military personnel retrieved dead bodies; however, bodies continued to litter the landscape of some affected areas for many weeks after the events and presented major logistical and social issues.

Most of the victims arrived at the hospitals or other healthcare facilities on foot or via cars, boats, or police vehicles; they presented within the first

few hours, creating a high, unevenly allocated patient load. Initially, there was no coordination between hospitals. In some areas of Thailand, hospital medical teams were deployed into affected areas to provide primary care and perform field triage, transferring only the more severely injured to the hospitals. Of the victims treated in the initial hours in primary care centers, 78% were assessed to have anxiety as their major problem, and 22% suffered soft tissue injuries.¹⁶

Within Country Responses

Neighboring states and provinces were the first to provide outside aid to affected communities. However, with the exception of Thailand and the Maldives, most assistance from unaffected areas of the affected country did not arrive until 1–2 days after the event — well after the time for most life-saving interventions. In Banda Aceh, the most substantially damaged city in Indonesia, the Indonesian government provided medical supplies and >100 nurses and doctors to supplement existing healthcare staff within the first two days after the events. In addition, the Indonesian military was actively involved in providing basic first-aid care in temporary treatment facilities. However, even the Indonesian military was unable to reach some of the damaged areas on the western coast. For the most part, field hospitals were not available until 3–4 days after the events. Meulaboh, the largest town on the devastated west coast of Indonesia, began receiving assistance on 30 December from 419 soldiers of the Indonesian Defense Force who parachuted into the town with food, medicine, and communications equipment.¹⁷

In India, assistance from neighboring states began arriving on 28 and 29 December. The Indian government sent 278 medical teams into the state of Tamil Nadu to establish 96 relief camps. Indian naval ships with supplies were sent to the Andaman and Nicobar Islands on 27 December, but were unable to reach areas of need for several days.

Of course, in many areas, local government ceased to function because officials were killed or were looking for family members. Thus, many surviving citizens were without leadership or local support.

International Responses

The outpouring of international assistance was unprecedented following the earthquake and tsunami events. Governments and hundreds of non-governmental organizations (NGOs) from around the world provided aid in terms of money, supplies, water, food, personnel, expertise, and other support. Relief to many damaged areas only could be delivered by helicopters provided by military units of foreign governments. Hospital ships from India, Germany, and the United States arrived off the shore of Indonesia to support

the care and treatment of victims in the Aceh Province. However, the ships could not dock and, thus, patients had to be transported by helicopter or boat to the ships. Civilian and military teams had to learn to work together to provide essential aid.

Hundreds of international humanitarian relief organizations responded to the enormous needs of the affected countries by supplying emergency commodities and necessary personnel.

In keeping with its traditional practice, India requested no international medical aid and all assistance in that country was provided by the central government as well as the generosity of the professionals within the country. Other than forensic expertise (both pathologists and equipment), Thailand also requested no international assistance, although it did not turn away help from other countries.

Relief Responses

Relief supplies by outside agencies and other governments began to arrive at some affected areas within 24–48 hours after the events. During the weeks that followed the events, relief responses concentrated on the treatment of injury complications and restoration of services, particularly water supplies and sanitation. These were provided by a huge influx of outside relief responders and massive amounts of supplies and equipment. The airports in Banda Aceh and Medan in Indonesia were overwhelmed with incoming flights and donated supplies; the control tower in Banda Aceh was operating out of a tent, communication was difficult, and unloading was undermanned and haphazard, creating a serious backlog of relief supplies at the airport. The Singapore government opened its air and naval bases to countries wanting to send relief supplies to Indonesia. In some instances, the logistics of managing supplies, particularly unnecessary supplies, was an additional burden, and some governments issued requests to send no further supplies unless specifically requested to do so.

Within days to weeks after the tsunami, field hospitals were set up and functioning to provide primary and surgical health care. The most common surgical procedures performed were fracture stabilization, wound debridement, and skin grafts.¹⁸ The traumatic injuries incurred as a result of the events demonstrated a typical trimodal distribution.⁶ The majority of victims who died from injuries did so immediately (Phase I). An unknown number of victims presented to healthcare facilities, but subsequently died either as a direct result of their injuries or due to the lack of resources to treat their injuries (Phase II). Phase III was evident by the development of numerous complications, such as aspiration pneumonia (“tsunami lung”), wound infections, acute pulmonary infections, non-cholera diarrhea, and, in Aceh

Province, an outbreak of tetanus in surviving victims. Few surgical procedures were required after the third day following the events. Thus, relief medical teams prepared and equipped for performing surgical procedures were more often needed to provide primary care to the victims, although this was not what they were prepared to do.

Relief medical teams also provided health care to internally displaced people residing in camps and other temporary housing. The most commonly encountered conditions in these settings included diarrhea, respiratory problems, and skin conditions.¹⁸

Initially, there was no effort or manpower to check the credentials of responding persons or organizations; coordination was a major problem. In addition, some areas experienced a glut of NGO responders. Many of these agencies did not share information with each other, which resulted in an excess of duplicate efforts/supplies in some areas, and few or none in other areas. At one time during the relief phase, there were >400 NGOs in Banda Aceh alone!

The actual and potential mental health issues of the tsunami victims were recognized quickly by both governmental and non-governmental groups. Numerous mental health teams were dispatched to the affected areas to provide necessary psychological support and treatment. Many worked independently, with no supervision or oversight by local health authorities; many were unqualified to provide the assistance they attempted to give and were inconsiderate of local culture and practices. For example, in Sri Lanka, mental health is not even part of that population's lexicon. Emotional distress is expressed through complaints of physical ailments (headaches, body pains, etc.).¹⁹ Great sensitivity and awareness of the local culture on the part of the caregivers were required to assess the individual's emotional state. Local mental health providers, if available, were essential to this process.

The Southeast Asia Regional Office (SEARO) of the WHO worked with the affected communities to develop community mental health programs and supplement available community resources to provide needed mental health and psychosocial support. These programs were developed to provide short-, medium-, and long-term support services to the victims in need.²⁰ Along with the WHO, the Indonesian ministry developed a mental health system as part of its primary care system, training physicians, nurses, and midwives to recognize mental illness and to provide basic psychological support. India developed a National Institute for Mental Health that created community support programs and linked psychosocial programs with other social services. In this way, the religious and cultural taboos regarding mental health could be overcome and assistance could be provided to those in need.

Of all the affected countries, Thailand possessed the most prepared and

organized system for providing necessary psychosocial support. Already in place was a group of >700,000 Village Health Volunteers who were available for rapid training and deployment to provide community-based psychosocial aid.²¹ In addition, all providers were closely supervised and coordinated by the country's Department of Mental Health.

CHALLENGES

Many of the challenges faced following the earthquake and tsunami are common to these events. However, the scope and magnitude of the combined events created challenges beyond the level usually encountered. Some challenges particular to the events are discussed below:

- Despite the fact that a surplus of relief supplies was sent to affected areas, a shortage of trucks to transport relief supplies, a widespread shortage of gasoline, and a lack of storage facilities resulted in the non-distribution of needed supplies;
- Many of the relief supplies, including medical supplies, were inappropriate to the events, climate, and/or culture;²² Approximately two-thirds of the drugs provided were beyond their expiration date; labels were in foreign languages; and many were inappropriate for the circumstances.²³ In addition, many of the relief teams came with supplies that did not include appropriate antibiotics to treat wounds and wound infections, the most commonly encountered medical needs;¹⁰
- The collapse of local government, such as occurred in Aceh Province, resulted in a total lack of coordination mechanisms;
- Many affected areas were no longer accessible by road, and there was a shortage of helicopters to transport relief supplies to them;
- Many of the injured and dead victims were tourists from other countries, which posed logistical problems in terms of identification, communication, and transportation. Many of the foreign injured victims were transferred to their respective countries for care; this was managed and provided by their native country. Local citizens voiced complaints that the government gave more importance to rescue and relief efforts of tourists;
- The surviving children faced numerous risks. Many were orphaned and taken in by relatives or family friends; orphan siblings sometimes were separated; many faced the risk of being befriended by criminal gangs who would sell them to sex traffickers.²⁴ In Sri Lanka, children faced the additional threat of landmines being dislodged by the tidal waves;
- The scope of the combined events resulted in mass numbers

of fatalities that the affected countries were unprepared to handle. Most forensic identification was made using dental and fingerprint information. However, forensic capacity was insufficient, refrigeration was not available soon enough; dry ice and temporary, shallow mass burials were techniques used to store large numbers of corpses;

- Victim identification was extremely challenging as proper storage of so many bodies for viewing and identification purposes was impossible. Photographs, video recordings, fingerprints, and basic personal information were relied upon for identification. However, within 24–48 hours after the event, decomposition began to distort the victims' features, making visual identification difficult;
- Temporary mass burials of victims occurred in most of the affected areas as a practical means of maintaining dead bodies in underground natural storage sites that were cooler than the ambient temperature; and
- The ongoing civil unrest in parts of Indonesia and Sri Lanka posed security concerns that restricted some relief in these areas. Prior to the events, humanitarian organizations had not been allowed into Banda Aceh, and safety issues remained a consideration after the events.

LESSONS LEARNED

- There is a great need for risk awareness education for all populations living in areas of risk;²⁵
- All countries and communities need to develop a preparedness plan for managing mass fatalities following disasters. This plan should detail: (1) recovery of the bodies; (2) transfer and storage of cadavers; (3) identification; and (4) final disposal of remains.²⁶ Photographs, fingerprints, and dental comparisons are far easier and cheaper to use than are DNA analyses for victim identification;²⁷
- Relief medical teams must be flexible and creative when providing care in disaster-stricken, austere environments;²⁸
- As has been noted previously,²⁹ the presence of large numbers of dead bodies within communities did not result in the spread of any diseases;
- DNA identification of victims is expensive, requires technical expertise, and is logistically challenging. It should be considered only in cases in which physical, fingerprint, and dental

identification methods are not possible; visual identification of bodies is the simplest method;²⁷

- Guidelines are needed regarding how to treat the dead while respecting the rights of the survivors. Emphasis must be placed on respect and dignity;
- The surgical burden of injuries occurred in only the first few days after the events. However, medical and, in particular, primary care needs were the prominent medical issues thereafter;²⁵
- Needs assessment information obtained by members of any one organization must be shared among all organizations to avoid duplicity in activities and resources. The initial distribution of essential supplies must be done according to the results of a thorough needs assessment;
- Input from and involvement of survivors in both relief and recovery interventions are essential. The presence of too many relief organizations may have a detrimental effect on the relief effort;²⁵
- Legislation is needed regarding policies and regulations of emergency response at a sectorial/regional level;²⁵
- National authority is needed to coordinate/direct national and international assistance within a country;²⁵
- All relief personnel, including the military, must be trained in cultural issues and sensitivities;
- Civil–military coordination and cooperation are essential to many relief efforts, and policies must be established before an event;
- Mental health services must be involved in disaster planning and preparedness and must become active in both relief and recovery responses; and
- The impact of the event is as great among healthcare providers as it is in the rest of the population. Thus, at the time of greatest need, surge capacity cannot be attained, and even usual, everyday care levels cannot be provided because of inadequate personnel. Non-medical volunteers must be trained to assist in providing emergency care during times of great need.

CONCLUSION

The devastating effects of the Indian Ocean earthquake and tsunami affected millions of people. In addition to the deaths of hundreds of thousands of victims — mostly women, children, and the elderly — the ensuing trauma experienced by the survivors continues today.

The events were experienced by many countries with varying levels of disaster preparedness. Clearly, those countries with greatest preparedness fared better than did those with little or none. We can only hope that the lessons learned from these events can help all of us to better prepare for future events.

AUSTRALIAN DISASTER MEDICAL TEAM IN BANDA ACEH

An Australian medical team was deployed to Banda Aceh on the fourth day after the tsunami bearing self-sustainability supplies, a medical cache, and equipment sourced from CareFlight and New South Wales Fire Brigades Urban Search and Rescue (17 tons in all).³⁰ The team consisted of:

- Two senior Australian Defence Force personnel (Team Leaders);
- Two orthopedic surgeons;
- Two general surgeons;
- Four anesthetists;
- Four emergency nurses;
- Four operating theatre nurses;
- Two emergency physicians;
- One infectious disease physician;
- Two operational logistics personnel; and
- One medical logistician.

The team was assigned to an abandoned private hospital just outside the impacted area, and to a functioning hospital in the inundated area for nine days. Upon arrival at the abandoned hospital, the team noted: (1) very few staff members (five doctors and 10 nurses); (2) few patients (approximately 20); and (3) an overwhelming smell of infection.

Caring for patients in the Emergency Department and the wards for 12–18 hours at a time, the team used most of the supplies they brought and modified other equipment to meet their needs. With almost no diagnostic equipment available, the team members had to rely on clinical assessments for diagnoses and treatment. The roles of the different team members often overlapped.

Having “ready-to-go” self-sustainability as well as disaster medical equipment allowed this team to mobilize and deploy quickly in a time of urgent need.

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CHAPTER 30

HURRICANE KATRINA: HEALTH ASPECTS

Anne Hutton and Helen Tilden

HURRICANE KATRINA CAME ASHORE in New Orleans, Louisiana, on Monday, 29 August 2005. This Category 4 storm was the most destructive natural event in US history, and caused destruction in four states (Louisiana, Mississippi, Florida, and Alabama) that totaled 90,000 square miles, an area the size of the United Kingdom.¹ In New Orleans, the massive rainfall resulted in the breaching of the city's levees with flooding that devastated the area's medical and public health infrastructure.¹ Overall, more than 1,800 deaths were caused by Hurricane Katrina and the subsequent flooding, and emergency officials "faced extraordinary demands for health services, including evacuation of thousands of hospital and nursing home patients".² Tens of thousands of individuals needed medical care following Hurricane Katrina, and >200,000 individuals with chronic medical conditions were without access to medications and the healthcare systems where they normally received care.¹ While many public health and medical challenges are expected in any disaster, the scope of the damage from these two events (the hurricane and the failure of the levees) posed unique response challenges, such as the loss or separation of medical records from patients, evacuation of medically fragile patients from flooded medical facilities, crippled communication systems, and the destruction of critical medical and public health infrastructure.

This chapter reviews the medical responses to Hurricane Katrina, and presents lessons learned for consideration in disaster planning.

OBJECTIVES:

- Understand the impact of the pre-event health status on the population affected by Hurricane Katrina;
- Describe the primary public health concerns following Hurricane Katrina; and
- Describe the primary challenges to healthcare facilities following Hurricane Katrina.

THE CHRONOLOGY OF THE EVENTS

On 25 August 2005, Hurricane Katrina, classified as a Category 1 hurricane with 130 kilometers/hour (80 miles/hour) winds, made its first landfall in southern Florida resulting in 14 deaths and some flooding. After leaving Florida and entering the Gulf of Mexico, the storm intensified quickly, growing from a Category 3 to a Category 5 hurricane with winds estimated at 255–280 kilometers/hour (160–175 miles/hour).

On Saturday, 27 August, the National Hurricane Center issued a hurricane watch for southeastern Louisiana, including New Orleans, as well as the coastlines of Louisiana, Mississippi, and Alabama. Voluntary and mandatory evacuations were issued to residents in these areas.

In the early hours of 29 August, Hurricane Katrina turned toward the Louisiana coast causing significant 4 meter (12 foot) storm surges and heavy rainfall; it made its second landfall in southern Louisiana, as a Category 3 hurricane with winds of 200 kilometers/hour (125 miles/hour). After moving across southeastern Louisiana, it made its third landfall near the Louisiana/Mississippi border, still at Category 3 intensity, with 195 kilometers/hour (120 miles/hour) sustained winds. Thereafter, Katrina traveled inland, finally losing hurricane strength more than 240 kilometers (150 miles) inland.

Midday on 29 August, the first levee breach occurred in the city of New Orleans causing flooding of approximately 20% of the city. On the following day, additional levees broke resulting in flooding of 80% of the city, with water levels reportedly up to 6 meters (20 feet) in some places.³

BASELINE STATUS OF HEALTHCARE INFRASTRUCTURE AND SERVICES

Prior to Katrina, the healthcare systems of the affected areas suffered from many fractured elements that increased the vulnerability of victims to the storm and subsequent flooding. According to the *United Health Foundation's America's Health: State Health Rankings 2004*, Louisiana and Mississippi ranked 50th and 49th, respectively, for overall health status before Hurricane Katrina.⁴ Nearly one of every five residents in Louisiana and Alabama lived below or at the national poverty level.⁵

Prior to Hurricane Katrina, one of five residents in Louisiana (approximately 90,000) were uninsured and the state had one of the highest rates of uninsured citizens in the country (21% versus 18% of all non-elderly Americans).⁶ Public insurance did not meet the health coverage needs of its residents, especially the adults. In 2003–2004, about 16% of the population in Louisiana, and 29% of Orleans Parish residents in New Orleans had state-provided Medicaid insurance coverage.⁶ Two-thirds of the nearly one million Medicaid enrollees in Louisiana were living in areas affected by Hurricane Katrina.⁶

Before Hurricane Katrina, many residents of Louisiana relied on public hospitals for health care. Compared to residents in other states, Louisiana residents were more likely to require hospitalization or visit a hospital's Emergency Department for their health care, and more Louisiana hospitals were publicly owned. In fact, the public hospitals provided 45% of all emergency care visits, 31% of inpatient stays, and 36% of all outpatient visits in 2003.⁷ Hurricane Katrina destroyed a system that often was the only healthcare resource for the poor.

Before Hurricane Katrina, Louisiana State University (LSU) operated 10 state-funded, inpatient hospitals and more than 350 clinics.⁶ One of these medical centers, the Medical Center of Louisiana at New Orleans (MCLNO), was the only Level-1 Trauma Center in the city, and included Charity and University Hospitals. These facilities were in need of repair, had documented deficiencies, and were struggling to meet healthcare standards prior to the hurricane.⁶ Charity Hospital served most of the poor and uninsured residents of southern Louisiana.⁶ More than 50% of inpatient care provided by Charity Hospital and a network of satellite clinics was to uninsured patients, and another 32% was provided to individuals with Medicaid insurance.⁸ The majority (85%) of the patients of the Medical Center of Louisiana at New Orleans had annual incomes of US\$20,000 or less.⁹ Within the New Orleans area, the Medical Center of Louisiana at New Orleans accounted for one of four (23%) Emergency Department visits, 14% of all hospital admissions, and nearly one of five (19%) total number of births.⁹ The facility also provided 407,000 outpatient visits per year within its clinic system.⁸

PREPAREDNESS ACTIVATION

Warnings of the arrival of Hurricane Katrina prompted some local hospitals to discharge ambulatory and stable patients. Some hospitals transferred patients to other facilities, although finding hospitals willing to accept the transfers was difficult, as all were facing the same hazard. Additionally, once the formal evacuation order was issued, roads surrounding the city became severely congested. There was no city or state plan to move hundreds of patients from numerous facilities. Hospitals that did have prior arrangements with ambulance services were unable to utilize them because of traffic issues, or because of superimposed city government control of the ambulances.¹⁰

For many patients, evacuation was deemed too great of a risk, and the decision was made to shelter-in-place, particularly as the city previously had weathered severe storms. Although the city of New Orleans was issued a mandate by the city's mayor to evacuate prior to landfall of the hurricane, hospitals were exempt from this order, and most of them did not do so.¹¹

IMPACT ON MEDICAL INFRASTRUCTURE

After Hurricane Katrina made landfall on 29 August 2005, hospitals in New Orleans lost electrical power. Emergency generators were used to operate vital equipment (dialysis machines, ventilators, and laboratory and x-ray equipment), and emergency lighting. The failure of the city's water pumping stations led to a fall in water pressure and an inability to flush toilets in hospitals without access to well water. The lack of air conditioning led to rising temperatures ($>90^{\circ}\text{F}$; 32°C) and humidity within the facilities. Telephone communications capabilities were varied and sporadic.

The following day, after the city's levees burst, massive flooding occurred throughout the city. In some hospitals, particularly those with generators housed below flood levels, the emergency generators failed, and all power was lost. Patients in these facilities needed to be evacuated, but the hospitals had lost the ability to communicate with the outside world regarding their acute needs. When communications equipment was available, many hospitals did not know who to call for assistance.¹²

The health status of patients with chronic medical conditions declined when they were unable to receive essential medications, oxygen, insulin, or kidney dialysis, and were exposed to high temperatures and humidity. Potable water, food, and medication supplies dwindled. (In addition to the patients, food and water had to be provided to family members and visitors as well as to staff and, in some instances, their families, and those individuals who had sought "shelter" at the hospital.) Ventilated patients had to be manually ventilated in darkness; in one hospital, nurses alternated 30-minute shifts to perform this function.¹⁰ Available family members were commandeered to assist with manual ventilation. Flash-lights provided light required for assessments and procedures.

Following landfall and the subsequent flooding from the failure of the levees, many hospitals became physically isolated, unable to communicate with local emergency responders, emergency officials, or other healthcare facilities to request staff, supplies, evacuation, or other emergency assistance. The ability to evacuate patients was limited by the lack of electrical power (no lights, no elevators); bed-ridden patients (and their vital equipment) had to be carried up or down stairwells. The surrounding floodwaters also impeded evacuation; only a few hospitals had helicopter accessibility. Patients in hospitals that weren't flooded were evacuated with greater facility. Those patients who were evacuated and transferred to other hospitals were transported by ambulances, boats, buses, or helicopters; the evacuation process took days to complete. Families were separated, and, importantly, parents were separated from their children.

Many hospitals, nursing homes, clinics, physician practices, pharmacies, specialty care facilities, and EMS resources were damaged severely or destroyed by the events. Following Hurricane Katrina, the Medical Centre of

Louisiana at New Orleans was closed and only seven acute care facilities remained in operation. Six months after Hurricane Katrina, New Orleans had 80% fewer hospital inpatient beds than it had before the storm.⁶

EMERGENCY MEDICINE AND PUBLIC HEALTH CONSIDERATIONS

Many of the public health problems that resulted from Hurricane Katrina were similar to those encountered in other flood and hurricane responses, including threats of food and waterborne illnesses due to the compromised safety of water supplies and the damaged sewage system. Foodborne illness and electrocution risks increased as a result of power line damage and power outages. Individual residents were at risk of traumatic injuries from the high winds and secondary injuries from accidents, drowning, carbon monoxide poisoning, punctures, and other wounds. Additional threats included bites from dogs, venomous snakes, and insects.

Individuals with chronic conditions who were not able to access health care after Katrina were at risk of dying due to exacerbation of their conditions. Chronic conditions (such as diabetes, renal failure requiring dialysis, drug addiction requiring methadone maintenance therapy, asthma, and hypertension) went untreated, as many evacuees had no access to medications and medical equipment. Other causes of death following Hurricane Katrina included dehydration and heat stress due to a lack of fresh water supplies and overcrowding in areas with poor ventilation; attic space entrapment also caused heat-related morbidity/mortality. Homicides and suicides were reported. Most survivors suffered emotional and mental trauma and cited anxiety, depression, and difficulty sleeping and eating.⁶ Many expressed the desire to talk with someone, but did not know where to obtain assistance.

STATE RESPONSES

On 26 August 2005, the governors of Louisiana and Mississippi declared states of emergency, and in Alabama, Louisiana, and Mississippi, emergency operations centers (EOCs) were activated to their highest levels of operations.¹ Mississippi activated 750 of its National Guard personnel and New Orleans mobilized 2,000 National Guard/personnel. Louisiana and Mississippi both initiated contraflow traffic plans, i.e., all traffic lanes were converted to one direction to aid traffic flow out of the cities, and local governments across the Gulf Coast issued evacuation orders. However, many Gulf Coast residents had become so accustomed to hurricane evacuation mandates that they ignored these orders.

After Hurricane Katrina made landfall, the state of Louisiana initiated a response focusing on both medical services provisions and amendments to exist-

ing programs. State–federal medical coordination was managed through the State EOC. Federal and state medical staff focused heavily on hospital evacuations; obtaining information on nursing home evacuations was difficult due to infrequent communications between the Nursing Home Association and the state EOC.

The state of Louisiana Emergency Operations Plan called for Louisiana State University Health Sciences Center (LSUHSC) to be the lead institution for coordinating hospital planning with private hospitals and other facilities; however, LSUHSC was unable to both coordinate the medical responses within the LSU system of hospitals and perform this lead role under the state plan.¹¹

Louisiana limited the use of the Emergency Management Assistance Compact to meet the medical support needs, and instead, relied on federal resources that were both self-contained and self-supporting. The state did not have the lodging, transportation, security, and supplies needed to support healthcare responders coming into the state.¹²

In 2004, the state of Louisiana had formed the Governor's Health Care Reform Panel to provide coordination and support for healthcare reform in Louisiana.¹³ As part of this initiative, the state had made significant progress in developing information systems to track patient outcomes.¹⁴ Following Hurricane Katrina, these systems were of critical importance in meeting the public health needs of displaced residents. A web-based immunization record system (LINKS) that tracked physician office, hospital, and public health clinic child and adult immunization records was utilized to provide information to health officials on 34,000 children who had been relocated to other states.¹⁴ Linking the system to the Houston–Harris County Immunization Registry in Texas allowed the state to locate >18,900 immunization records, providing a cost savings of more than US \$4.64 million in potential vaccine and vaccine administration fees — a previously unrecognized use of immunization information systems.¹⁵

Another free, secure system, KatrinaHealth.org, was developed within two weeks of the events to allow physicians across the United States access to prescription drug and allergy information on Katrina evacuees through a partnership with health groups. The Centers for Disease Control and Prevention (CDC) helped expand the state infectious disease surveillance and reporting system to allow for tracking shelters and field hospitals.¹⁴

The state of Louisiana also worked to implement policies to ensure that Medicaid health services continued for beneficiaries. The state issued temporary Medicaid insurance cards to clients who lost their cards as a result of the hurricane, and waived all prior authorization requirements to facilitate in-state and out-of-state services for beneficiaries by providers willing to accept Louisiana Medicaid payments. The state also placed staff in Federal Emergency

Management Agency (FEMA) assistance centers and shelters to help victims complete Medicaid applications.⁷

THE FEDERAL RESPONSES

By the time Hurricane Katrina made landfall, the FEMA had logistics centers located in Alabama, Louisiana, Georgia, Texas, and South Carolina, and had staged 400 truckloads of ice, more than 500 truckloads of water, and nearly 200 truckloads of food.¹ This was the largest staging of federal resources in the history of the United States. The federal medical response was led by the US Department of Health and Human Services (HHS). In advance of the storms, the HHS and the Department of Homeland Security (DHS/FEMA) mobilized resources and personnel including: a Rapid Needs Assessment team; the HHS Secretary's Emergency Response Team; National Disaster Medical Assistance Teams; Disaster Mortuary Operational Response Teams; a Veterinary Medical Assistance Team; National Disaster Medical System (NDMS) Management Support Teams; NDMS medical caches; and Federal Medical Stations. Other assets were mobilized and sent to Louisiana, Mississippi, and Texas. The HHS and the NDMS teams had independent chains of command in deploying these resources and personnel.¹² Prior to the hurricane's landfall, a reception, staging, and storage area was set up that was consistent with the state's Strategic National Stockpile plan. A CDC team arrived before the storm to support this effort, and the CDC provided many of the supplies for this system, including drugs and vaccines. The NDMS used its own Medical Logistics Function for the response and encountered shortages of oxygen, life-saving medications, and experienced re-supply challenges to its field units. The Department of Defense also had an operating Medical Logistics Function.¹²

On 31 August (two days after the hurricane struck), the HHS Secretary declared public health emergencies in Alabama, Florida, Louisiana, and Mississippi in response to the damage created by Hurricane Katrina. When thousands of evacuees from these states began arriving in Texas, the Department Secretary declared a public health emergency in the host state of Texas. On 07 September 2005, public health emergencies also were declared in Arkansas, Colorado, Georgia, North Carolina, Oklahoma, Tennessee, West Virginia, and Utah.¹⁶

Federal personnel were deployed to assist in conducting a Medical Needs Assessment, but the state of Louisiana declined to have this team conduct the assessment;¹² the team did not have a medical component. Instead, the state relied on facility self-reporting to obtain assessment data during the early phases of relief response. Public health and medical assessments were not conducted until the end of the first week after the storm. This impacted deci-

sions made by federal and state officials who needed actual numbers, not projections of the number of dead and/or injured.¹²

The US Public Health Service deployed >2,500 Commissioned Corps officers and over 1,200 unpaid federal employees to serve as physicians, nurses, pharmacists, dentists, engineers, administrators, environmental health officers, veterinarians, mental health experts, and mortuary experts in areas of need.¹⁷ As of 16 September 2005, the CDC had deployed the Strategic National Stockpile and more than 150 staff specialists to the affected states.¹⁶

The CDC made specific recommendations for controlling disease in the aftermath of the hurricane including: (1) immunization of emergency responders, relief workers, and evacuees; (2) education of the responders, emergency officials, and the public on the risks of tetanus from wounds, and the risks for the development of influenza, measles, chickenpox and hepatitis A in crowded conditions with children that had not been vaccinated; and (3) alerting health officials of the risk of *Vibrio* infection in hurricane victims, which could result in loss of affected limbs or death within days.¹⁶ The CDC also provided assistance to hurricane-impacted states in the areas of medical care, epidemiology, sanitation, environmental health, assessment, disease surveillance, public information, and health risk communication.¹⁶

More than 87 National Disaster Medical System (NDMS) teams were deployed to the affected areas as of 09 September 2005, with available teams from all 50 states deployed as part of the initial response. One NDMS team was pre-deployed to the New Orleans Superdome shelter.¹⁶ A Disaster Medical Assistance Team (DMAT) was deployed to the New Orleans International Airport on 01 September 2005; the team's After Action Report describes an overwhelming need for patient assessment and treatment during the first four days of the deployment during which time there also was a shortage of food and water. The team triaged and treated evacuees needing medical care and requiring transport to healthcare facilities, in addition to processing evacuees with no medical conditions. The team estimated that there were >21,000 displaced residents who did not require medical care, and between 3,000 and 8,000 who were provided with medical care.¹⁸ The team cited numerous command and planning issues that included:

1. Failure to implement the Incident Command System (ICS) or any form of command and control structure;
2. The lack of a uniform command among the many participating agencies in the relief response;
3. Failure to clearly define the roles and responsibilities of the Management Support Teams;
4. The absence of any liaison role with military and other civilian agencies participating in the relief response, and a lack of understanding of the role of the US Public Health Service

- representative(s) at the airport;
5. The absence of any liaison with local medical providers, public health officials, or local emergency medical responders;
 6. The absence of the system necessary to respond in a first response role (NDMS is designed to respond 48 to 72 hours after an event, i.e., after an event has stabilized);
 7. Failure to utilize an Incident Action Plan;
 8. The lack of veterinary support until late in the mission;
 9. The lack of awareness/timing of hospital and nursing home evacuations leading to difficulty tracking patients or locating patients treated in the medical unit;
 10. The lack of plans for dealing with family members who accompanied victims;
 11. The lack of a standard operating procedure for the use of medical volunteers;
 12. The lack of a standardized response (e.g., each DMAT team used its own approach to triage and patient movement);
 13. Inappropriate use of DMAT personnel who lacked training or experience to load and unload patients from helicopters; and
 14. Inadequate medical caches that were not updated and lacked critical equipment, such as ventilators.¹⁸

On 08 September 2005, the US President signed an emergency supplemental appropriation for Hurricane Katrina Relief authorizing up to US \$100 million to maintain Katrina-related NDMS response operations.¹⁶

The Department of Defense assisted with Hurricane Katrina operations and made hospital beds available aboard the USS Bataan, USS Iwo Jima, USS Tortuga, and USS Shreveport ships. The Department of Defense also had 20 Navy ships on station in the region to provide medical support, humanitarian relief, and transportation.¹⁶ However, competing operational priorities and delays in approval complicated many of the requests made to the Department of Defense for their use.¹²

The Department of Veterans Affairs (VA) also helped with the coordination of available hospital beds during Hurricane Katrina and activated 17 NDMS Federal Coordinating Centers to coordinate patient and veteran evacuations from temporary and permanent hospital facilities.¹⁶ National guardsmen began evacuating patients from the New Orleans VA Medical Center as early as Tuesday evening (30 August).¹⁹

EVACUATIONS

Large-scale hospital evacuations began in New Orleans on 01 September, three days after the hurricane hit.¹⁶ Complicating evacuation efforts were reports of

sniper fire threatening hospital evacuations. The Associated Press reported that an unseen gunman was in a nearby high-rise building and was shooting at Charity Hospital staff as they attempted to evacuate critically ill patients.²⁰ Other news reports described shots being fired at military helicopters.²¹ These reports later proved to be false, but they played a role in delaying the arrival of resources from other states due to safety concerns.²²

Many of the patients from damaged healthcare facilities and shelters were taken to the Louis Armstrong International Airport outside New Orleans, which had been turned into a temporary field hospital, where patients were triaged and prioritized for transport (Figure 30.1). However, the DMATs at this staging area faced overwhelming numbers of patients and were unable to save some of the hurricane victims. Due to major damage to healthcare facilities in the area, patients were evacuated to facilities across the South Central United States, and often were separated from their families and medical records along the way.¹⁶



Photo by Michael Rieger/FEMA. Available at www.photolibrary/fema.gov/photolibrary/photo_details.do?id=15093

Figure 30.1: Survivors of Hurricane Katrina at New Orleans Airport where FEMA's DMAT teams set up a medical hospital and from which people were flown to shelters in other states

SHELTERING

Shelters for those patients with special needs were established by the state and supported with federal staffing. Federal Medical Stations were set up to care for special needs victims in Alexandria, Louisiana and at the Louisiana State

University (LSU) campus in Baton Rouge, Louisiana. Medical staff was sent to other special needs shelters throughout the state when Louisiana State's Department of Health and Hospitals declined the use of a shelter in Alexandria. Some NDMS teams also were utilized to staff special needs shelters.¹² Medical care was provided in general population shelters and in special needs shelters.

In addition to the SuperDome and the Convention Center in New Orleans, shelters for the general population were set up in host communities throughout the United States. In a survey of victims evacuated by air from Louisiana to the Austin, Texas, Convention Center, 20.7% had a skin rash upon arrival, 18.7% reported diarrhea, nearly half (49.8%) had symptoms of an acute illness, and nearly 60% of the adults had at least one chronic condition.²³ At the Katrina Clinic, a clinic set up to care for evacuees at the Houston Astrodome/Reliant Center Complex, healthcare staff saw >11,000 of the 27,000 evacuees during a two-week period. As the nearest large city to New Orleans, Houston received many of the evacuees who arrived dehydrated, delirious, and with exacerbations of chronic medical and psychiatric conditions.²⁴ Common health and health-related problems included: uncontrolled hypertension, respiratory infection, acute gastroenteritis, need for medication refills, uncontrolled diabetes, asthma, dermatitis, and mental health problems.²⁴

SPECIAL POPULATIONS

Many older adults, institutionalized individuals, medically fragile, homebound individuals with developmental disabilities, children, and the uninsured represent vulnerable populations who are unlikely or unable to provide or advocate for themselves. As a result of the devastation from Hurricane Katrina, many of these individuals became disconnected from social, family, and/or provider supports.²⁵

Veterans

Through the Department of Veterans Affairs, the US government provides health care (both inpatient and outpatient) to veterans of active service in the US armed forces. When Hurricane Katrina struck, there were 1.5 million veterans residing in Alabama, Louisiana, and Mississippi, with 50% receiving services from the VA. The VA medical centers in Gulfport, Mississippi, and New Orleans, Louisiana, the New Orleans Regional Benefits Office, and five community-based outpatient clinics were impacted by the hurricane. Patients were moved from the Gulfport, Mississippi, VA Medical Center before Katrina made landfall. The VA's Crisis Response Team (CRT) closely monitored the developing situation; by 07 September 2005 (nine days after the event), the VA had evacuated 241 patients, 272 employees, and 342 family members from its New Orleans-based medical center,

and had re-established service at all community-based outpatient clinics. Seven mobile clinics were deployed to Mississippi and Louisiana. In addition, the Katrina Veteran Response System allowed VA pharmacists to access the pharmacy records of the displaced patients.²⁶

While the VA worked to repair their damaged infrastructure, many aging and frail veterans had to travel far distances to receive care that they had received in their home communities. Although the VA system allows its members to receive emergency care at any medical facility, non-emergency care (e.g., laboratory work or elective surgery) must be received within VA facilities.²⁷ Despite efforts by the VA, a study of national patterns of outpatient service use demonstrated that veterans from New Orleans and Biloxi-Gulfport were, respectively, 73% and 41% less likely to use any outpatient services in September 2005 compared to 2003–2004 outpatient visits, and the decline in mental health/substance abuse services was twice as large as the decline for general medical services visits.²⁸

Children

The youngest survivors of Katrina faced multiple challenges as well. However, a year before Hurricane Katrina, several of the Gulf States had begun participating in the Southeastern Regional Pediatric Disaster Response Network and planning for disaster scenarios that would impact pediatric patients.²⁹ The Network met the week before Hurricane Katrina to identify planning gaps and identify related strategies. As a result of this coordination, even before landfall of the hurricane, the Arkansas Children's Hospital was in communication with Tulane University Hospital and the Children's Hospital of New Orleans. Following landfall, Tulane University Hospital in New Orleans requested Arkansas Children's Hospital's Angel One air transport service to assist with the transfer of three pediatric patients, while Texas Children's Hospital transported 18 more of Tulane University Hospital's pediatric patients and anticipated transporting 50–60 more patients in the initial 48 hours after landfall. While no coordinated plan existed, transport teams from five hospitals in surrounding states voluntarily assisted with dozens of evacuations of pediatric patients by ambulances, helicopters, C-130 aircraft, and small, donated, private planes.³⁰

Key to the success of these evacuations and transfers was the establishment of an intermediate staging area outside of New Orleans staffed by a pediatric nurse who triaged the patients based on age, physical size, medical status, and the number of medical devices that needed to accompany the patient. This nurse also was in communication with both the referring and receiving hospitals. This provided essential central coordination and communication. The creation of this staging area also was the work of the *ad hoc* working group of transport teams from surrounding state pediatric hospitals.³⁰

Some pediatric patients were transferred to facilities in the disaster-impacted states and many children and their families were transferred out of the state; most were transferred to Alabama, Florida, Georgia, Missouri, Tennessee, and Texas. In Baton Rouge, Louisiana, pediatric medical directors from the hurricane-impacted area decided to centralize emergency pediatric care at the Pete Maravich Assembly Center (PMAC) at Louisiana State University, which was transformed into a field hospital. Staff, volunteers, and interns from Louisiana State University–New Orleans and Tulane University medical training programs provided health care at the field hospital.³¹ Prior to Hurricane Katrina, no plan for regionalization of pediatric specialized services existed; there was an overall perception that adult caregivers could substitute for specialized caregivers, especially given the cost of transporting pediatric patients out of the disaster area.²⁹

Obtaining supplies for pediatric patients initially was a problem, as the Strategic National Stockpile had no nebulizers, Pedialyte fluids, or pediatric crash cart equipment. In addition, staff had no pharmaceutical supplies for the patients who were treated at the assembled field hospital. The healthcare team reached out to local pediatric and pediatric sub-specialty offices asking for pediatric medical supplies, formula, diapers, and other needed items. Within hours, the team obtained enough supplies to provide services; some came from receiving hospitals that sent needed items back via returning aircraft carriers.³¹ The Louisiana State University Reserve Officers' Training Corps (ROTC) also assisted with resupply by initiating a command and control of supplies that were donated by pharmaceutical and medical device companies, as well as international medical aid charities.³¹

The pediatric emergency care staff cared for patients with the usual pediatric illnesses, as well as children with exposure and dehydration from the evacuation, a few snake and rodent bites, minor trauma, and one infant who experienced near-drowning.³¹ Three days after landfall of the hurricane, the assembled field hospital staff was augmented by federal personnel from the Illinois Medical Emergency Response Team (IMERT) and the New Mexico Disaster Medical Assistance Team.³¹

In addition to disrupting acute medical care services, Hurricane Katrina disrupted the care of children with chronic medical conditions. Children with chronic conditions are at an increased risk during healthcare disruption following natural disasters and, thus, more likely to be at an increased risk for adverse outcomes.³² St. Jude Children's Research Hospital in Memphis, Tennessee airlifted two dozen critically ill patients and treated more than 100 pediatric cancer patients whose treatment had been disrupted by the hurricane. The hospital also sent healthcare staff members to Baton Rouge, Louisiana, to assist with the care of local pediatric patients.³³

In Houston, Texas, pediatric evacuees received care at the Katrina Clinic from physicians from the Texas Children's Hospital and the Ben Taub General Hospital. These pediatricians provided care to arriving evacuees around the clock, treating more than 65 patients needing intravenous fluids at the peak of operations. By the time the clinic closed two weeks later, 3,500 infants and children had been cared for in a two-week period.²⁴

Older Adults

Older adults (>60 years of age) accounted for approximately 15% of the population of New Orleans before Hurricane Katrina. Seventy-one percent of the hurricane-related fatalities occurred in individuals over the age of 65 years.³⁴ Older adult survivors were traumatized by evacuation, the destruction of personal property, and disrupted connections with family and friends.²⁵ At the Katrina Clinic in the Houston, Texas, shelter, workers struggled to identify the special needs of older adults; sensory impairment prevented some from hearing announcements or reading signs, while others had significant cognitive impairments.²⁴

The Uninsured

As a result of the hurricane, the number of uninsured residents in the Gulf Coast grew as survivors lost jobs and their employee-sponsored health insurance. In the immediate aftermath of the storm, many uninsured survivors were able to obtain medical care and medications, but this became increasingly difficult as emergency healthcare programs ended. Due to job uncertainty and strained finances, many survivors could not afford medical care or medications. After Katrina, officials had to consider what to do with individuals who lost their medical insurance due to businesses closing, how to pay for care for the uninsured, and what to do with Medicaid beneficiaries who evacuated to other states.³⁵

Survivors in Baton Rouge, Louisiana, and evacuees in Houston, Texas, reported that the number of resources for free or lower-cost care was significantly less than in the New Orleans area.²⁵ Individuals with Medicaid insurance fared better than did those without insurance; however, evacuees who moved to other states found some providers unwilling to accept Louisiana Medicaid insurance.²⁵

RECOVERY

Rebuilding the damaged Gulf Coast's medical infrastructure has been a slow and challenging process. Many survivors went without needed health care and medications for weeks and months following the storm.²⁵ Many residents remained unable to connect with primary care or specialty providers six months after the hurricane, and as a result, their physical and mental health declined. A total of 4,486 doctors and 1,270 medical residents were displaced from the New Orleans' metropolitan area. As of February 2006, the physician population for

the New Orleans' metropolitan area was as low as 1,200. The number of nurses that renewed their licenses by July of 2006 decreased by 27%, and 18 months after the hurricane, there were 969 nursing vacancies in New Orleans and the surrounding areas.^{36,37} Returning healthcare workers faced the challenges of rebuilding practices, caring for the remaining residents, and rebuilding medical educational programs.³⁸ The residents of New Orleans have struggled to find healthcare providers and clinics, have experienced long waiting times in Emergency Departments, and have had difficulty accessing specialty care.²⁵ As of April 2006, only 15 hospitals were open with a bed capacity of 2,200, compared to 22 hospitals with 4,400 beds in and around New Orleans before Hurricane Katrina.³⁹ Another report suggests that the number of hospital beds lost may be as high as 6,000.¹⁶ While challenging, the rebuilding of the Gulf Coast healthcare infrastructure provides the opportunity to design a new system that eliminates disparities and promotes healthy living, including the rebuilding of communities with sidewalks, bike paths, and parks.¹⁴

LESSONS LEARNED

DeSalvo and Kertesz⁴⁰ suggest that while disasters, such as that which followed Hurricane Katrina, have been rare in terms of magnitude, emergency managers can gain valuable insight into planning considerations applicable to future events of any size. The disaster plans that existed in the regions damaged by Hurricane Katrina were insufficient to meet the medical and public health needs of the impacted population. Some valuable lessons include:

- Hospitals serve a community and are responsible for the safety and well-being of large numbers of people who are unable to care for themselves. Hospital emergency planning must involve stakeholders from within the community, the region, the state, as well as from neighboring states. The loss of essential infrastructure mandates outside support that must be arranged and incorporated into emergency planning;
- Healthcare facilities must be able to withstand severe weather, both externally and internally; this includes ready access to sufficient supplies and personnel;
- Effective internal and external emergency communications systems, including wireless telephone systems, must be established;
- Emergency planning must define an effective leadership structure for disaster management;
- Hospital and community healthcare workers must receive appropriate education and training, regularly exercise disaster plans, and conduct regular reviews and updates of the plan;

- Evacuation plans must be incorporated into preparedness planning; plans must include agreed upon policies regarding which patients will be evacuated first; plans also must address the evacuation of family, refuge seekers, and staff;
- State agencies must review disaster planning to ensure medical facility evacuation plans are realistic and include plans for regional evacuations. The competition for transportation resources should be considered in these plans;
- Advance arrangements should identify which hospitals will be used for evacuated patient transfers; preferably, an external coordination center should be created to determine patient transfer designations, leaving healthcare personnel to care for patients;
- A method of tracking evacuees must be developed in the event patients are separated from their family;
- The healthcare system must provide a safety net for the poor; large-scale disasters often expose previously under-recognized system frailties that will fail when under stress;^{25,35,40}
- Health officials must make a sustained effort to connect people with medical care and medications during disasters. Providing coverage with a broader set of eligibility criteria may increase survivors' access to care;
- Health officials must address all of the barriers to health care and must integrate information on health resources with information on housing, jobs, child care, food, and transportation;²⁵
- Emergency plans must include a special focus on the most vulnerable individuals, and responders must make sustained efforts to reach these individuals; Federal and state officials must plan how to integrate federal Medical Station resources with state plans and resources for caring for these populations;
- The Federal role in caring for homebound and long-term care patients must be clarified;
- Federal, state, and local disaster planners must consider how to provide regionalized pediatric care. The need for pediatric medical supplies also must be considered as part of planning efforts as providers may not have enough supplies for two to three days, given the current regionalized pediatric care system;²⁹
- A single, unified medical logistics supply chain must be established for all federal agencies providing services. The HHS must develop a concept of operations to utilize strengths and resources of partnering agencies and be prepared to bring

oxygen, medications, supplies, and medical transportation to the response. This concept of operations must support a federal oxygen generation system, a controlled pharmaceutical system in the field, and established contracts for ground and helicopter patient evacuation to support local and Federal operations in a timely manner;²⁴

- An interoperable, electronic, medical records system that is accessible across the healthcare system is needed to provide essential patient information to receiving institutions; medical records became separated from some patients that were evacuated post-Katrina, posing serious problems for the receiving hospital; and
- Agencies in all levels of government must identify strategies to rebuild critical medical infrastructure.

CONCLUSION

Thousands of people in the Gulf coast region of the United States received medical care following Hurricane Katrina, and hundreds of lives were saved due to the thousands of dedicated medical providers that responded to the call for volunteers. Despite the heroic efforts by medical personnel, many lives were lost. In *A Failure of Initiative: Final Report of the Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina*, the Committee concludes that there was “a lack of planning, lack of initiative, and lack of response”.⁴¹ William Lokey, the FEMA Coordinating Officer in Louisiana, told the US Senate Committee on Homeland Security and Government Affairs, “The locals were overwhelmed. We were going to be overwhelmed. There was no way, with my experience and what I had to bring to the table, I was taking a knife to a gunfight”.⁴²

Hurricane Katrina exposed major weaknesses and inequities in numerous basic societal functions, most profoundly in the healthcare sector. As the affected communities and people struggle, still, years later, to return to a state of normalcy, the lessons learned from the experience of Hurricane Katrina must remain forefront in disaster preparedness planning on the part of individuals, communities, states, regions, and countries. Such an event undoubtedly will reoccur; the outcome must be different.

HEALTH RECORDS DURING A DISASTER

Displaced victims of Hurricane Katrina were relocated to areas throughout the United States. An online, central source of information, www.KatrinaHealth.org, was created for authorized health professionals to update evacuees' medication information in order to renew prescriptions, prescribe new medications, and coordinate care.⁴³ This Website allowed authorized users access to the medication histories of evacuees of Hurricane Katrina, including prescription information from government and commercial sources, such as electronic databases of community pharmacies, government health insurance programs, private insurers, and pharmacy benefits managers.⁴³

A summary of lessons learned from the use of www.KatrinaHealth.org include:⁴⁴

- Create electronic health information systems that are based on simple, open web standards, so that data can be provided in different formats and from different users, yet be accessible to all;
- Agree upon a method to authenticate the identities of doctors, pharmacists, other health professionals, and patients using the Website, so that they can quickly and securely access private health information needed for ongoing treatment;
- Make electronic health information records also accessible to nurse practitioners, physician assistants, and nurses who likely will be working with physicians and in clinics during a disaster; and
- Examine federal and state public policies governing privacy and medical records, such as the Health Insurance Portability and Accountability Act of 1996 and existing state privacy laws, to be sure they do not hinder the delivery of medical care for displaced persons during a disaster.

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CHAPTER 31

DISASTER NURSING EDUCATIONAL COMPETENCIES

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HEALTHCARE PROFESSIONALS and public health officers are considered by many to be the first line of emergency defense^{1–6} with a goal to deliver an acceptable quality of care while saving as many lives as possible.⁷ Providing health care during a disaster presents many unusual challenges, including working in an uncertain environment, managing scarce resources (human and material), safety risks, and caring for patients at their most vulnerable time.⁸ Because resources are insufficient, creativity and improvisation are required.⁹ To be successful in a disaster, nurses must be appropriately trained to provide the right response. Yet, currently there are no accepted, standardized requirements for disaster nursing training or continuing education.^{10–17} The lack of a single source of authority or an approved body of emergency preparedness content or curriculum has resulted in unfocused training and educational efforts.¹⁸ As a further consequence of this lack of educational consensus, preparedness often is inconsistent and lacks integration between healthcare systems.

OBJECTIVES:

- Define the term *competency* and how it relates to disaster nursing education;
- Discuss problems in developing a standardized list of competency requirements for mass-casualty events; and
- Identify additional resources that nurses can access to acquire more disaster nursing education.

EDUCATIONAL NEEDS

Education and training constitute key components of disaster preparedness. As early as 2002, the American Nurses Association (ANA) issued a position statement outlining the responsibilities of nurses in the event of a catastroph-

ic event. Included in this declaration was the message that nurses must educate themselves to adequately respond in the case of a local, state/province, or national disaster. In addition, the report emphasized nurses' obligation to educate the public regarding disaster preparation/response.⁸ However, some recent studies suggest that many nurses continue to feel ill-equipped to respond effectively should a large-scale public health emergency occur.^{9,19-21}

After the terrorist events of 11 September 2001 in New York City, there was an upsurge of educational offerings for healthcare providers geared toward expanding their knowledge about chemical, biological, radiological, nuclear, and explosive threats. However, as events such as the Southeast Asia tsunami, Hurricane Katrina, and the threat of pandemic influenza have underscored, these programs often fail to be comprehensive and lack an appropriate focus on training for all hazards. Additionally, while these programs often provide knowledge, their design limits the development and practice of necessary skills, such as critical decision-making.

Some individuals argue that adequate education for disaster response/preparedness requires uniform standards across healthcare disciplines.²² They advocate the creation of foundational core competencies for healthcare disciplines in order to establish a common educational framework^{8,23-26} with competency-based, objective evaluation.²⁷ Others suggest that emergency preparedness training be required continuing education,²⁸⁻³⁰ while still others believe that disaster healthcare training should be a requisite for medical privileges or licensure.³¹

Despite the fact that two of the most influential nursing organizations in the United States, the ANA³² and the American Association of Colleges of Nursing,¹ support required educational content on emergency preparedness, neither group recommends any specific content. Although significant efforts have been made to identify fundamental knowledge necessary for nurses responding to mass-casualty events (MCEs), the creation of a standardized, comprehensive, emergency/disaster educational curriculum for nurses has not yet been accomplished.

In the absence of federally mandated educational criteria, several groups have independently attempted to develop core competencies for emergency/disaster preparedness without attempting to coordinate the competencies across the many types of emergency responders. Some disaster healthcare roles that have been addressed include emergency medical technicians, physicians and nurses,³³ hospital workers,³⁴ and public health workers.^{34,35} Groups that have addressed disaster nursing core competencies include the American Red Cross,³⁶ the Association of Teachers of Preventive Medicine,³⁷ and the International Nursing Coalition for Mass Casualty Education.³⁸ Unfortunately, the identified core competency requirements are inconsistent across these groups.

COMPETENCIES

One method to standardize disaster-focused nursing curricula is to develop objective, measurable competency statements.³⁹ Competencies delineate skills, knowledge, and actions necessary to demonstrate professional expertise.⁴⁰ As a general rule, the theoretical content and skills necessary for any clinical profession, nursing included, are dynamic and continuously developing,⁴¹ making the generation of competency statements challenging. Nevertheless, both physician and nursing leaders have affirmed the need for competencies-based curricula to guide practice.^{41–43} Practice based on pre-tested, measurable competency statements helps to ensure standardization, proficiency, and accountability. Although a complicated task, groups in the United Kingdom⁴⁴ and in the United States⁴⁵ have honed both general nursing and specialty core competencies into manageable sets of required skills.

Deriving essential disaster preparedness core competencies for the entire nursing workforce, however, may be more problematic. Attempts to create a comprehensive set of nursing disaster preparedness competencies have been hampered by several factors. To date, no standardized definition of what constitutes disaster nursing preparedness exists. Educational preparation for nurses still varies; nurses who graduated after 2001 may possess a better grounding in disaster preparedness-related theory compared to nurses who graduated before that time. This age-related variation may be a significant issue, particularly in light of the “graying” of the nursing pool. In addition, there are few nursing faculty members prepared to teach the concepts of disaster preparedness, and nursing school curricula already are weighed down with content, leaving little or no room for additional material. Another consideration is that nurses practice in diverse roles and arenas; what constitutes adequate educational preparation for a public health nurse may be very different than for a nurse who practices in critical care or who would be a first receiver in a hospital Emergency Department. Finally, the skills and didactic information necessary for nurses to function competently in a large-scale public health emergency or disaster have yet to be systematically tested.

DISASTER NURSING COMPETENCY EFFORTS

Despite these impediments, attempts have been made to generate core competencies for nurses practicing in a disaster setting. In 2003, the International Nursing Coalition for Mass Casualty Education (INCMCE), now re-named the Nursing Emergency Preparedness Education Coalition (NEPEC), convened a group of stakeholders from various professional groups who generated and published a set of basic core competencies for general nurses working in emergency/disaster situations. The efforts of this group resulted in the identification of 104 competency statements that address critical thinking, assessment,

technical skills, communication, core knowledge, and professional role development relative to disaster nursing.^{38,49} The identified competencies were intended to develop a competent nurse workforce able to respond to MCEs. Nevertheless, these competencies have not been universally accepted, nor have they been subjected to rigorous testing to determine if they adequately reflect the skills and information that the majority of nurses need in order to be proficient in an emergency/disaster setting.

COMPETENCY DOMAINS	CORE COMPETENCIES	EXAMPLES
1. Fundamental attitudes to emergency and disaster nursing (e.g., ethical practice, professional responsibility)	1. Competencies related to preparedness, organization of response	1. Health policy, organizational, and personal planning for emergencies
	2. Practical competencies related to the health team and basic human care	2. Care provision and management. The WHO key public health technical priority areas for action in emergency settings: mass-casualty management; maternal, newborn, and child health; non-communicable diseases, including mental health/psychosocial support; communicable disease surveillance and control; nutrition; healthcare delivery services; pharmaceuticals; and biologicals
2. Systematic assessment and provision of disaster nursing (e.g., basic knowledge)	3. Nursing competencies for needs assessment and planning, providing, and managing care	3. Situation and needs assessment
3. Care for vulnerable people and their families (e.g., care for children, women, the elderly, and the disabled)	4. Practical competencies to treat people with special health needs, i.e., vulnerable groups and addressing gender-based violence	4. Special concerns: caring for the most vulnerable, gender and gender-based violence, security and personal safety, psychological issues
4. Care management in emergency and disaster situations (understanding local systems)	5. Competencies for maintaining the care environment and team system, e.g., communications (information sharing), supply chain, cold chain, water supply, equipment	5. Environmental health, including water, sanitation, and hygiene
5. Professional development (e.g., reporting nursing practice)	6. Competencies for professional development, including monitoring, mentoring, and evaluation	6. Leadership, coordination, and team work in emergency settings; professional development, accountability, legal, and ethics

Table 31.1: World Health Organization (WHO) competency domains and competencies for nursing and midwifery in emergencies⁹

In its *Altered Standards of Care in Mass Casualty Events*,⁴⁷ the Agency for Healthcare Research and Quality proposes that efforts be directed toward continuing and expanding opportunities to train healthcare providers and others to respond effectively to MCEs. It recommends that components of preparedness training be included in the original training of each healthcare provider discipline and in ongoing competency-based training. Further, it suggests that role- and condition-specific competency training be based on the “doctrine of routine”, which assumes that healthcare providers will do best in the practice areas that they do most often, but also recognizes that extensions and expansions of healthcare provider roles are likely to occur during an MCE. Also included are their recommendations for “just-in-time” training, when appropriate, especially for those skill sets that differ from usual practice.

The World Health Organization (WHO) has recognized that mounting an effective disaster response requires an agile healthcare workforce with specialized skills.⁹ It recently developed a unified competency model based on competencies identified by the INCMCE and the University of Hyogo. Based on five key competency domains, the WHO has developed six groups of core competencies for nursing and midwifery in emergencies (Table 31.1).

In 2007, in ground-breaking action, the National Organization of Nurse Practitioner Faculty (NOPF), funded by the National Nursing Emergency Preparedness Initiative (NNEPI), convened the National Panel for Advanced Practice Registered Nurses (APRN) Emergency Preparedness and All-Hazards Response Education to identify and recommend fundamental emergency preparedness content that nursing faculty could incorporate into graduate-level nursing courses. Eleven nationally recognized clinical competencies generated by the Association for Prevention Teaching and Research (APTR)/Center for Health Policy-Columbia University School of Nursing served as the organizing framework for the panel’s recommendations. Broad curricular concepts as well as suggestions for content and resources are outlined for each specific competency.⁴⁸

Finally, the International Council of Nurses, a federation of national nurses’ associations representing nurses worldwide, is in the process of defining a set of competencies geared towards international disaster response efforts. A current draft of their efforts identifies 17 competencies in three domains: fundamental attitudes toward disaster nursing; systematic assessment and provision of disaster nursing care; and care provision for vulnerable people and their families.⁴⁹

Most existing competency documents are lists of general abilities without specific outcome measures. For example, the Agency for Healthcare Research and Quality has identified seven broad competencies listed as statements.¹⁰ Hsu and others define seven generic competencies that cross-cut among various

healthcare disciplines.¹⁵ The International Nursing Coalition for Mass Casualty Education (NEPEC) has identified four core competencies, six major areas of core knowledge, and six major areas for professional role development

AGENCY FOR HEALTHCARE RESEARCH AND QUALITY ¹⁰	CROSS-CUTTING COMPETENCIES FOR HEALTHCARE WORKERS ¹⁵	REGISTERED NURSES (INCMCE/NEPEC) ^{38,49}	PUBLIC HEALTH WORKERS (COLUMBIA UNIVERSITY AND CDC) ^{34,35}
1. General disaster responses, including an introduction to altered standards of care 2. Legal and ethical basis for allocating scarce resources in a mass-casualty event 3. Orientation on how incident management would work in a mass-casualty 4. How to treat populations with special needs 5. How to recognize the signs and symptoms of specific hazards 6. How to treat specific conditions 7. How to recognize and manage the effects of stress on themselves and their patients	1. Recognize a potential critical event and implement initial actions 2. Apply the principles of critical event management 3. Demonstrate critical event safety principles 4. Understand the institutional emergency operations plan 5. Demonstrate effective critical event communications 6. Understand the incident command system and your role in it 7. Demonstrate the knowledge and skills needed to fulfill your role during a critical event	1. Critical thinking: use an ethical and nationally approved framework to support decision-making and prioritizing needed in disaster situations 2. Assessment: perform an age-appropriate health assessment 3. Technical Skills: Demonstrate the safe administration of medicines 4. Communication: Describe the local chain of command and management system for emergency response during a mass-casualty event	1. Describe the public health role in emergency response in a range of emergencies 2. Describe the agency chain of command in emergency response 3. Identify and locate the agency emergency response plan 4. Describe his/her functional roles and responsibilities and demonstrate his/her roles in regular drills 5. Demonstrate correct use of all communication equipment used for emergency communication 6. Describe communication roles 7. Identify limits to knowledge, skills, and authority and identify key system resources for referring matters 8. Apply creative problem-solving and flexible thinking and evaluate effectiveness of all actions taken 9. Recognize deviations from the norm and describe appropriate action

Table 31.2: Examples of existing healthcare provider competencies. (INCMCE = International Nursing Coalition for Mass Casualty Education; CDC = Centers for Disease Control and Prevention)

encompassing 104 different competency statements.^{38,50} These 104 items are intended to apply to all professional nurse roles and practice settings and are intended to be included in all entry-level nursing programs. The Columbia University School of Nursing and CDC assert that all public health workers must be competent in nine objectively measurable skills with public health “leaders” requiring an additional seven competencies and public health “professionals” (not defined) requiring an additional three competencies.^{34,35} Table 31.2 compares the competencies described by these four groups.

DISASTER EDUCATION

Although criteria to evaluate professional competency is an essential educational component, the necessity for effective disaster response training continues to be overwhelming, given the large number and varied education and experience of nurses in the existing workforce. Similar to the difficulties encountered with competency standardization, how best to effectively educate healthcare professionals in general, and nurses in particular, in disaster response remains open for discussion. In an evidence report, *Training of Clinicians for Public Health Events Relevant to Bioterrorism Preparedness*⁵¹ the Agency for Healthcare Quality and Research found that preferred training methods varied by audience and skill level, and included disaster drills, table-top exercises, computer simulation, satellite broadcasts, video conferences, continuing education programs, and conferences. It is unclear which methods are most effective for disaster response education, what type of training best promotes learning, or how frequently training must be repeated to facilitate retention.

One major advance in standardized education is the National Disaster Life Support (NDLS) program, which is a series of three courses offered under the sponsorship of the American Medical Association (AMA).⁵² Modeled after the Basic and Advanced Life Support courses, the NDLS courses provide broad-based, prehospital-oriented instruction, particularly about chemical, biological, explosive, and nuclear hazards. However, the courses must be taught by AMA-certified instructors, may be expensive to attend, and may be unavailable in rural areas. The NDLS program material also has shortcomings for nurses, as much of the information focuses on the prehospital response, rather than hospital response, and nursing roles are not specifically addressed.

Developing computer-based education specifically for nurses constitutes a viable alternative to the time-consuming, labor-intensive, and often costly process involved in creating traditional educational programs. Proponents of self-paced on-line strategies suggest that nurses may find the training more convenient, more accommodating to their work schedules, and easier to repeat particular modules until mastery is achieved.⁵³

Dr. Betsy Weiner at Vanderbilt University School of Nursing was one of the first nursing educators to recognize the potential usefulness of the computer as a tool to disseminate nursing-focused disaster preparedness education. Under her direction, INCMCE (now NEPEC) developed six on-line, interactive modules based on the disaster nursing core competencies identified by INCMCE in 2003.^{38,50} These modules can be accessed free of charge at the NEPEC website (www.incmce.org).

Another on-line disaster response training program focusing on nurses' responsibilities during disasters is jointly sponsored by the American Red Cross and Sigma Theta Tau International Society; it is available at www2.nursingsociety.org/education/case_studies/cases/SP0004.html. Nurses who wish to obtain a certificate in disaster preparedness may pay a fee and register for on-line continuing education courses offered by the St. Louis University School of Nursing (http://nursing.slu.edu/cne_disaster_prep_home.html). To obtain the certificate of completion, each individual must successfully finish a 10-module program.

In a project funded by the Department of Homeland Security, the National Nurse Emergency Preparedness Initiative (NNEPI) is creating a series of six interactive modules providing comprehensive disaster preparedness and response training for general practice nurses. Continuing education credit is available for a small fee. The modules are available at www.nnepi.org/online_course.shtml.

SCHOOL OF NURSING PROGRAMS

Despite nursing educators' recognition of the need for formal, basic disaster preparedness education, few schools of nursing have increased appreciably the number of hours devoted to this content.⁵⁴ Efforts to expand the disaster preparedness content in schools of nursing have been hampered by such factors as inadequately prepared faculty, overloaded curricula, and poorly defined fundamental education principles.³⁴

Some nursing scholars suggest that adequate disaster preparedness curricula for undergraduate students minimally entail a required semester-long course rather than a short overview lecture woven into an existing course.⁵⁵ However, most nursing schools have very little room in the curriculum for such courses. For the most part, disaster nursing content is integrated into community health and adult health courses, generally in the form of a two- or three-hour lecture.⁵⁶⁻⁵⁸ Since no consensus exists as to specific fundamental content elements, validated behavioral skills and competencies, or relevant curricular threads, it is likely that nursing school disaster preparedness curricula will remain dependent on individual faculty knowledge and perceptions of the requirements to adequately prepare nursing school graduates.

CONCLUSION

Recent disasters from natural events and terrorist attacks have underscored the need for disaster and emergency preparedness. It is recognized that well-trained health workers save lives and that mounting an effective disaster re-sponse requires an agile healthcare workforce with specialized skills. Training and education are integral to disaster preparedness, yet there continues to be no specific emergency preparedness standards for training or assessing disaster preparedness of nurses. Despite efforts to make education and training a priority, limited research has been conducted evaluating the content, quality, quantity, or effectiveness of emergency preparedness training or response efforts.

Future efforts should address the systematic development of disaster preparedness education for the healthcare workforce established on evidence-based practices, sound educational theory, and quantitative outcome measures. These represent an important gap to be filled in disaster preparedness efforts throughout the world.

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CHAPTER 32

DISASTER NURSING RESEARCH

Dean Whitehead and Paul Arbon

RESearch THAT UNDERPINS and reports disaster healthcare practices is growing rapidly. However, conducting scientific research in this area is ethically and practically both complex and difficult.¹ Thus, it is not surprising that the collection of research data during disasters often is not a priority for responding healthcare professionals. The majority of research concerning health planning, response, and recovery from a disaster is descriptive of the situation either before or after the event.^{2–4} Achieving evidence-based practice requires that disaster healthcare professionals seek new ways to understand the health aspects of a disaster and to evaluate their practice, both within and beyond the relief phase, and both in real time and retrospectively. Of course, some disaster-related problems only can be researched at certain times, such as with post-traumatic mental health issues and the responses of both individuals and entire communities to a disaster.⁵ There is considerable opportunity and need for research that contributes to the science of disaster health care and supports the way that we prepare for and respond to the health aspects of a disaster. The challenge is to develop research approaches that ensure robust findings and allow us to compare findings across studies, across events, and across societies, in an effort to improve the quality of the evidence that supports our practice. Nurses, who generally comprise the largest component of the healthcare responses to a disaster, are able to provide leadership in identifying gaps in supporting evidence, and in promoting effective research endeavors in this field of inquiry.¹ The aims of

OBJECTIVES:

- Assist nurses in providing leadership in identifying gaps in disaster healthcare practice by using research to evaluate their practice;
- Identify and explore effective nursing-related research practices and how they might best be utilized for disaster health research and evaluation of care; and
- Provide existing examples of the use of these various research methodologies.

this chapter are to identify and explore effective nursing-related research practices, how they might best be utilized, and to provide examples of the use of the various methodologies.

THE CURRENT SITUATION AND THE CHALLENGES FOR DISASTER RESEARCH IN NURSING

Many of the practices employed in both disaster planning and management have been tried and tested in everyday clinical practice, but are not necessarily based on primary research evidence. Tacit and experiential knowledge tend to dominate. However, these knowledge bases are only part of the evidence that constitutes evidence-based practice (EBP) — and often are the least rigorous. Of all the health-related professions, disaster nursing currently is least supported by a body of research evidence, although this is beginning to change. From an educational and training perspective, there currently are few recognized competencies for disaster nursing that are either widely accepted or that have a strong evidence base.⁶ However, the International Council of Nurses (ICN) is developing disaster nursing competencies, which are designed to support the development of appropriate education of nurses across fields and levels of practice. They also have launched the Disaster Response Network to support the work of developing these competencies (www.icn.org.ch).

Disaster education for nurses is in a relatively early stage of development in most countries, although this depends on the local context and incidence of mass-casualty events. For example, most nursing schools in the United States (no doubt in response to the heightened awareness and experience of the 9/11 terrorist attacks) offer at least some content on disaster preparedness in their undergraduate and postgraduate programs.⁷ What is needed, however, are more advanced levels of education that reach all healthcare professional groups in all countries. Tierney's⁸ recent "call to arms" for all nurses to be "disaster prepared" emerged from her response to findings from a descriptive survey of Hong Kong nurses' disaster preparedness, which found that no Hong Kong nursing establishments offered any disaster training at any level.⁹ Rebmann¹⁰ has suggested that disaster nurses should attend at least one educational offering each year. More advanced educational preparedness programs are emerging. For example, MacFarlane *et al*¹¹ report on the Masters of Public Health Degree in Disaster Management at Witwatersrand University in Johannesburg, South Africa. Part of this program includes specific and comprehensive content on appropriate research methods and biostatistics for conducting disaster-related research. Similarly, Baldwin *et al*¹² report their on-line Bioterrorism Response Education program for multi-dis-

ciplinary health service personnel, primarily aimed at preparedness roles for public health nurses in a bioterrorism event.

The general level of understanding of the healthcare aspects of disasters and the roles of nurses in a disaster remain varied and confused.¹³ A corollary to the relative lack of evidence-based knowledge among nurses is the pervasive belief in common disaster myths. Some misconceptions are strongly held¹⁴ and, despite years of refutation by experts, many professionals still believe that dead bodies constitute a health hazard if they are not disposed of quickly. De Ville de Goyet¹⁵ notes that the disaster myths most deeply rooted and believed are the oldest ones: the widespread existence of panic, the inevitability of looting, and the high risk of an epidemic among the affected population. Despite the fact that these beliefs have been overturned by research long ago, many health professionals still adhere to their misplaced context. These examples of myth and misconception highlight the requirement not only for further research, but also for effective strategies to implement existing research findings into our teaching and practice.

Disaster-related Nursing Research

Walker *et al*¹ categorize the research of mass casualty events and disaster into three distinct areas:

- Research related to the education and training, preparedness, and safety of responding personnel (including mental health);
- Research related to patients at the individual, family unit, and community levels; and
- Research related to health system communication and collaboration during response and recovery.

A search of the disaster nursing literature identifies studies addressing issues in each of these areas.

Research projects, such as those described, provide important information useful in the planning, preparation, and recovery phases of disasters. In turn, they help us to develop better education and training, improve information, and provide effective preventative and response services. Numerous other examples of nursing research exist, and each contributes to the growing body of knowledge in this field. However, there remains an important gap in the body of knowledge related to the application of clinical interventions within the real-time context or situation of a disaster, i.e., during the relief-response phase. Subsequently, little research addresses the special considerations involved in providing immediate care to those affected by a disaster at the site of a disaster. In particular, there is the need for the development of research approaches that evaluate health-related interventions during a disaster.

The practical difficulties associated with accessing disaster sites and collecting data in these situations also need to be identified and priority strate-

gies developed to assist researchers contemplating disaster research. This can be done only through close scrutiny and evaluation of practices that occur close to, or during, the time of the disaster.

Research related to the education and training, preparedness, and safety of responding personnel

This area of study is probably best represented in nursing-related disaster research. Mitani *et al*¹⁶ surveyed the expectations of Japanese nurses regarding minimum conditions, information, essential knowledge, and briefing required by nurses responding to a disaster. Mody and Cinti⁴ performed a pilot survey study in five US-based nursing homes to assess the status of preparedness for a pandemic outbreak of avian influenza. Guscott *et al*² assessed the mental health responses of the nursing staff at the Royal Darwin Hospital involved in caring for victims of the Bali bombings in 2005. French *et al*¹⁷ interviewed hospital emergency department nurses who responded to Hurricane Floyd and compared their needs and concerns with the hospital disaster protocol for hurricanes. Similar to work done by Gebbie and Merrill¹⁸ to identify competencies for public health workers, Polivka *et al*¹⁹ conducted a Delphi study to establish consensus on public health competencies in the event of a public health surge related to a disaster. Arbon *et al*²⁰ compared the experiences of nurses responding to the Sumatra-Andaman earthquake and tsunami of 2004 with the profile of other Australian nurses who volunteered through an Australian Government free-call hotline. The study considered the challenging situation in which nurses were required to work, as described in interviews and written accounts, and contrasted this with the analysis of quantitative data obtained through the hotline responses from 3,600 nurses who volunteered their services.

Research related to patients at the individual, family unit, and community levels

Rosenkoetter *et al*³ conducted a survey, using the Older Adult Disaster Evaluation Assessment Tool, to investigate the evacuation responsiveness of US-based, lower socioeconomic older adults in the event of a disaster due to a natural event. Oflaz *et al*²¹ recently investigated the effects of both psychoeducational and psychopharmacological interventions on Turkish earthquake survivors. Chen *et al*²² collected data from 113 US-resident, Vietnamese survivors of Hurricane Katrina in New Orleans. Nozawa *et al*²³ surveyed the residents of a high-risk community in Japan regarding their awareness of typhoon evacuation procedures. Zotti *et al*²⁴ studied a US-based, multi-state, faith-based program for children affected by a disaster from a natural event. Woerschling *et al*²⁵ researched El Salvadorian residents who were affected by two major earthquakes in 2001. They assessed post-earthquake conditions

related to health care and access to health care, as well as housing, food, sanitation, and water.

Research related to health system communication and collaboration during response and recovery

O'Boyle *et al*²⁶ utilized focus groups to develop recommendations on interventions that would support the ability of nurses to work effectively during a disaster response, and to facilitate better communication and multidisciplinary collaboration. Recommendations included specific measures to improve safety, reduce anxiety, increase trust in hospitals, and provide physical and emotional support for nurses. Nasrabadi *et al*²⁷ used semi-structured, serial interviews to explore Iranian nurses' experiences in disaster relief following the Bam earthquake in 2003.

TOWARD A BROADER AND MORE EFFECTIVE RESEARCH AND EVIDENCE BASE FOR DISASTER NURSING

Several international collaborations support the development of research and evidence-based practice in disaster health care. These include the World Association for Disaster and Emergency Medicine (WADEM), the International Council of Nurses (ICN), and the Cochrane Collaboration. These collaborations provide the opportunities to network, draw in resources to support research, develop strategic plans or priorities, share research findings effectively, and apply these findings to the education and practice of the healthcare workforce. The *Nursing Insight* publication, which is available to members of the WADEM, is a useful publication that communicates new research findings and promotes linkages and collaboration. Since 1994, the WADEM and several collaborating organizations have been developing the Utstein Research Guidelines in an attempt to provide a framework for disaster research.²⁹ The role of the guidelines is to guide research initiatives using a standardized, structural format. To facilitate this, they identify the mechanisms of disasters, a specific research process, and provide a generic research template for conducting and reporting findings from disaster research. (See Chapter 33)

The ICN has developed a Disaster Nursing Response Network, which provides web-accessed disaster nursing resources (www.icn.org.ch). The Centre for Research on the Epidemiology of Disaster (CRED) (www.cred.be) promotes research, training, and information dissemination on disasters, with a special focus on public health, epidemiological, structural, and socio-economic aspects. It aims to enhance the effectiveness of developing countries' disaster management capabilities as well as foster policy-oriented research.

In addition, many national government emergency management organiza-

tions provide access to research reports and libraries that support research work, including the Australian government agency Emergency Management Australia (EMA), and the US Federal Emergency Management Agency (FEMA), which provides >10,000 pages of information on its Website (www.fema.gov).

Disaster Research Awareness

At the individual level, several factors influence the successful implementation of research and the application of research evidence in clinical settings. Practitioners developing a research and evidence-based approach to health-care delivery require a number of key and core skills. According to Whitehead and Arbon,²⁹ these skills include:

- An understanding of the concepts of effectiveness, safety, and acceptability to ensure that the intervention being assessed achieves the desired patient outcomes;
- The ability to access and assess the quality and generalizability of any clinical evidence presented. This includes access to resources, such as databases and journals, and the capacity to critically read and interpret published research. For most health professionals, both at the undergraduate and postgraduate level, searching for, understanding, and translating the existing empirical research literature constitute the initial steps in promoting evidence-based practice and sound practice-change principles;
- The ability to assess the applicability of the findings to the local population follows from the critical review of the literature. Published research studies may have been undertaken in populations with varying degrees of similarity to the local population of interest. Assessing the local applicability of research findings involves determining if the populations and context are similar enough to warrant changes based on the published findings, or if further research involving the target population is required; and
- The capacity and skills to affect practice changes. Nurses working to change practice by applying evidence-based findings require a working knowledge of research practices and leadership skills to promote acceptance of the recommended changes.

Research Frameworks

Recognized impediments to the successful application of research in the disaster field include:²⁹

- a lack of accepted definitions for disaster and the health affects of disasters;

- a lack of conceptual frameworks able to provide a structure for the study of disasters and to challenge researchers to (re)consider relationships between important variables; and
- a lack of endorsed sets of indicators or data points that can be used in research studies.

The definitions utilized in describing and reporting disaster research vary and depend upon the focus of the study and the discipline involved. For example, a term as straightforward as “medical usage rate” (MUR) can have different meanings in the hospital and pre-hospital contexts and between medical practitioners and other health professionals. To overcome this difficulty, researchers should use terms that are well-recognized, clearly define the term in their research writing, and consider adopting definitions that are emerging by consensus in the research literature. Gunn’s *Multilingual Dictionary of Disaster Medicine*³¹ is gaining acceptance as a source of agreed definitions, although further work is required to develop consensus about many terms. *The Health Disaster Management Guidelines for Evaluation and Research in the Utstein Style*²⁹ provide a glossary of terms that can help researchers in adopting consistent definitions in research work. (See Chapter 33.) Another useful source of accepted terms to consider for nursing research is the International Classification for Nursing Practice (ICNP) of the International Council of Nurses (www.icn.ch/icnp.htm).

Conceptual models provide researchers with the opportunity to develop theory and to identify and describe possible linkages between factors and influences in their area of study. While such models often are criticized because they must simplify the relationships between key features in disaster health, they benefit the discourse in disaster research because they provide a means to describe relationships and interactions, and to discuss the evidence that underpins these relationships. Established thinking can be challenged by conceptual models and investigators can develop their research to confirm or to refute the ideas that the models represent. For instance, *The Health Disaster Management Guidelines for Evaluation and Research in the Utstein Style*²⁹ provide a conceptual framework for use in disaster health research. This framework provides a structure for researchers undertaking work in the disaster health field and is a tool that will help to ensure that the research findings can be compared among studies, thus facilitating evidence-based approaches and the conduct of systematic reviews within an intelligible research effort. The framework divides a disaster into longitudinal phases common to all disasters that provides strong face validity for researchers and clinicians working in this area, and may provide the most appropriate division of fields of concern to underpin research questions. Examples of the use of this framework are offered in Chapter 33.

Ultimately, the value of conceptual models lies in their ability to highlight

existing gaps in our knowledge, and to generate new research questions. Model templates are derived from consensus about the mechanisms of a disaster and the determinants of disaster health, and can assist researchers in undertaking research that can be compared with other work in the field and also to articulate current concepts and present them for challenge by others.

Evidence-based Practice, Practice Development, and Practice Change

The introduction of evidence-based practice (EBP) in the mid-1990s marked a significant shift from care based on routine and ritual to that based on practices that have been shown to work best in achieving the desired outcomes. Fineout-Overholt *et al*³² comment that EBP has become a driving force for problem-solving and improving clinical practice and cost-effectiveness of care. Subsequently, EBP and its related disciplines, such as practice development (PD), have become familiar terms to many nurses and other health professionals during the past decade. Webster *et al*³³ argue that these concepts have become acceptable to clinicians because they are intuitively sensible. Many healthcare organizations have invested heavily in strategies to increase the likelihood that all clinical practice is evidence-based, wherever possible. To a certain extent, this has also been the aim of disaster organizations.

The terms *knowledge*, *evidence*, and *research utilization* often are used interchangeably and have become discussed widely in the literature. Stetler,³⁴ Kitson *et al*,³⁵ and Estabrooks³⁶ originally moved the boundaries in nursing by beginning to make explicit the links between EBP and PD. McCormack *et al*³⁷ highlighted the need for practice development as a primary mechanism for creating work environments that sustain evidence-based, person-centered practice, thus providing both a framework and the methods for making EBP a reality. These links also are part of the Promoting Action on Research Implementation in Health Services (PARIHS) project,³⁸ which acknowledges that successful implementation of evidence into practice is more likely if a systematic, explicit, and context-specific approach to facilitation is adopted. The PARIHS framework proposes that evidence, context, and facilitation are interrelated and influence the success of evidence utilization in practice. This program is used to assist practice change in many countries worldwide. Closely linked to the work of the PARIHS project is the methodology of PD, which is used to gain an in-depth understanding of practice context so that the most appropriate, facilitative approach to using and generating evidence in and from practice is adopted.³⁹

The key processes of PD are consistent with and operationalize the PARIHS framework. They include:

1. Clarifying values and beliefs about the particular development focus;

2. Identifying the existence of these values and beliefs in practice;
3. Identifying the gaps that exist between the espoused and the real values through processes of inquiry and evaluation;
4. Ensuring that systematic approaches to developing practice are negotiated and action plans put in place to develop practice; and
5. Ensuring that the model of facilitation that is negotiated with key stakeholders includes a sustainable commitment to learning from the processes via reflective learning strategies, such as action learning⁴⁰ and supported reflective practice.⁴¹

Rycroft-Malone *et al*⁴² suggest that practice change requires consideration of three key elements: evidence, context, and facilitation. For example, where there is little primary research evidence to guide a clinical decision, clinicians predominantly use their experience and feedback from past patients in determining how to care for the patient. Clinicians should be wary, however, of changing practice where insufficient research evidence exists.

Sometimes existing evidence has been developed in one context of care and must be assessed for its suitability and application in another care context. This requires further “translational” research whereby the existing evidence is interpreted or investigated within a different clinical context. Context refers to the environment in which the proposed change is to be implemented. Organizations that provide a questioning, learning environment, and a commitment to staff empowerment are more likely to support EBP. Thus, the ideal environment for practice changes is one in which there are clear roles and responsibilities, effective teams, an organizational structure that supports change and leaders, and one that encourages innovation by all staff levels. In order to change, people may require help to delineate what needs changing and how they can facilitate the achievement of whatever is the desired outcome.

Fundamentally, the goal of research in health care is the improvement of clinical practice and health outcomes; all forms of research evidence ultimately should contribute to our ability to achieve this goal. Occasionally, however, individual pieces of evidence or lower-level evidence are used in a fairly unsophisticated way to support changes in practice. The evidence-based medicine (EBM) movement is focused on overcoming this problem and promotes the assessment of all available evidence, rates the evidence in terms of the reliability and validity of the research approach and its application, and applies these findings to the development of clinical guidelines that are based on the best available evidence at any point in time. The highest level of evidence arises from the results of randomized, controlled trials (RCTs); either a simple RCT or a series of them. However, most of the data gathered in disaster settings cannot comply with the rigorous requirements of controlled trial research. Imagine the moral, ethical, and legal implications of conducting experimental trials where one

experimental group of disaster refugees/personnel are exposed to a treatment or procedure and compared to a control group that is denied the same treatment or procedure in order to measure impact and outcome. Furthermore, with most forms of experimental (or even quasi-experimental) designs, any form of control in adverse conditions is extremely limited. Nevertheless, there are some examples of the use of these methods that exist in disaster research. However, other research approaches must be considered for use in disaster settings. The strength of research evidence can be rated and classified using commonly accepted research hierarchy parameters (Table 32.1).⁴³

EBM provides statistical as well as other methods of aggregating and analyzing data from a range of studies (e.g., systematic reviews, statistical meta-analysis) that are useful and provide the basis for developing clinical practice guidelines.

Evidence-based, clinical practice aims to take into account the context within which care is provided; the preferences of the client(s); the clinical judgment of the healthcare professional; and the best available evidence. These considerations have arisen from concerns about the ways in which we undertake research and improve practice. Within our own healthcare institutions, many of us have seen clinical practice change in response to research undertaken locally or by influential practitioners. Occasionally, these changes have been challenged in response to new evidence, or evidence that existed, but was not considered. The evidence-based approach minimizes such occurrences through (1) the active seeking of all available evidence; (2) weighing of this evidence; (3) comparing the evidence with the findings of all

CLASSIFICATION	EVIDENCE
I	Evidence obtained from a systematic review of all relevant randomized controlled trials
II	Evidence obtained from at least one properly-designed randomized controlled trial
III-1	Evidence obtained from well-designed, pseudo-randomized, controlled trials (alternate allocation or some other method)
III-2	Evidence obtained from comparative studies (including systematic reviews of such studies) with concurrent controls and allocation not randomized; cohort studies; case-control studies; or interrupted time series with a control group
III-3	Evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group
IV	Evidence obtained from case series, either post-test or pre-test/post-test

Table 32.1: Levels of evidence according to the Australian National Health and Medical Research Council (NHMRC)⁴³

relevant studies undertaken in an area; and (4) developing conclusions that are supported by the best available evidence. For more information on EBM, consult the Cochrane Collaboration Website (www.cochrane.org). The Cochrane Collaboration is an international non-profit organization that provides information on evidence-based healthcare interventions. It produces and disseminates systematic reviews of healthcare interventions, and promotes research in areas where evidence is scant. In 2004, there were more than 11,500 persons working within the Cochrane Collaboration⁴⁴ in over 90 countries; half of these workers are authors of Cochrane Reviews. Several specialist centers have been established under this umbrella, including the Joanna Briggs Institute (www.joannabriggs.edu.au), which incorporates a focus on nursing research evidence, and the Cochrane Prehospital and Emergency Health site,⁴⁵ which supports the collection and review of pre-hospital care research (www.cochraneprehf.org). The deliberate assessment and application of evidence to practice are expected: (1) to benefit consumers through improved outcomes of care; (2) to benefit nurses by providing access to best practice information that is trustworthy and providing the rationale for their practice; and (3) to benefit healthcare organizations by ensuring that their service is effective, limits unforeseen harm, and can be justified to their stakeholders.

Searching for the Current Best Evidence

Accessing information on the best approaches to disaster-related health care has become increasingly difficult. For example, it is estimated that there are approximately 1,000 new publications each year relevant to surgical nursing.⁴⁶ While nursing-based disaster literature currently exists, it is drawn from a broad range of nursing specialties, including emergency nursing, theatre (operating room) nursing, mental health nursing, community nursing, public health nursing, and primary health care nursing. However, not all specialties may identify with the research base of other specialties. In addition, because healthcare practitioners seldom are able to specialize in disaster health, efforts to stay up-to-date may be hampered by the need to focus on the literature relevant to their primary area of practice, rather than on disaster nursing literature. Mirroring these issues, Sackett⁴⁷ highlights the following issues regarding health service-related research, in general:

- There is a lack of research-based information to support clinical decision-making;
- There is a lack of research-based guidelines and protocols to use in clinical practice;
- There is an overwhelming volume and variability of new journal information; and

- There is an inadequacy of traditional sources of information (e.g., outdated textbooks).

The research and evidence-based literature must be more notable and accessible for disaster nurses. In disaster nursing research, it is not the volume of research that presents a problem, but, rather, the paucity of published research reports, and the difficulty in making comparisons across different studies. The use of standard terminology and structure, such as the *Utstein Guidelines*, (Chapter 33) hopefully, will reduce, if not eliminate, these issues.

RESEARCH APPROACHES

Broadly, research methodologies provide us with access to objective reality available through independent and repeated observation or to the subjective reality of individuals, which may vary from person to person. Research using quantitative data explores an orderly, rational, objective physical world that can be measured, and is unaffected by the experiences or perspectives of the observer. Research using qualitative data usually explores the relative and personal, subjective, “lived world” of people. Thus, quantitative research considers phenomena such as causation, treatment effectiveness, economic and organizational issues, and prognosis. Qualitative research explores the meaning of situations: What has happened? What is perceived? What will it be like? What is experienced? Qualitative research tends to focus on process rather than measurable outcomes. Methodologies used in nursing research are the positivist, reductionist, and empirical approaches that utilize quantitative data, and the critical or interpretive approaches that utilize qualitative data.

Evaluations

As a result of the relatively early stage in the development of the disaster health-care discipline, and the difficulties associated with collecting data and applying rigorous research designs in disaster situations, there is a need to begin with evaluations of current practices. This involves the collection of baseline data for the development of foundational or basic science in this field. Often, evaluation studies are exploratory and lead to the generation of a hypothesis that becomes the foundation for more focused, future, research studies.

As the field of disaster research matures, we can expect to see more sophisticated research designs being implemented to test and seek answers to more complex ideas and questions in disaster health care.

Research

The overall objective of disaster research has been described as:
to attenuate or eliminate the damage from disasters. This could

result from the elimination of hazards, decreasing the risks for the actuation of the hazard, augmenting the absorbing capacity of the society and environment at risk and enhancing the efficiency, effectiveness and cost:benefit of preparedness and responses to the disaster.⁴⁸

Research that considers the application of basic knowledge to a particular situation often is referred to as translational research. *Translational research* may be defined as the process of applying ideas, insights, and discoveries generated through basic research to clinical practice in a particular area. There is a need for translational research in the field of disaster health. Opportunities exist for this work in many nursing specialties in which there is knowledge about nursing interventions that are effective, but that need to be tested and, perhaps, modified to better suit the needs of disaster-affected individuals. For example, much is known regarding effective strategies to manage acute pain, but little is known about the practical difficulties in the use of analgesics in disaster areas where access to equipment, power, the supply chain, and other issues must be considered, and which may affect decisions about best practice in that setting. In a similar fashion, nursing practices in providing primary health care, psychological first aid, triage, surgery, pediatric nursing, geriatric nursing, etc., must be studied in relation to disaster health care. The scope for research in disaster nursing is broad, and there exist many opportunities for nurses to research practices in this field.

Because conducting research prospectively in disaster situations presents many practical difficulties, studies of the outcomes of a response or intervention or that describe a specific disaster event dominate the literature. These reports often are anecdotal in nature and do not build on previous research or utilize standard data points, indicators, or terminology. There is a need for research that results in findings that can be generalized, support the development of standards, and aid decision-making in future events.

Disaster health research is accompanied by novel issues in the ethics of human research, and, in particular, problems of informed consent, autonomy, independent versus participant observation, and the testing of new interventions. There is a need to consider the development of suitable research methods for studying disasters taking into account different types and locations of disasters, the rapid collection of data, and access to data. Research is required to support disaster health practices, including:

- The development of tools and instruments for the standardized, reliable collection of data;
- Studies that develop or test response and recovery concepts and theories;
- Studies that assess the effects, efficiency, costs, and benefits of

- specific interventions on both clients and providers; and
- Studies assessing health services, including healthcare policy, as well as the professional services and skills that enhance disaster healthcare delivery.¹

The choice of methodology and research design are determined by the nature of the research question or problem. Research focused on the outcomes of care or the efficacy or efficiency of particular interventions, for example, might utilize empirical methods and seek quantitative data, whereas research that seeks to determine the subjective experiences of people affected by disasters likely would seek qualitative data, and therefore, employ interpretive or critical approaches. Practitioners should consult experienced researchers for advice about the most appropriate type of study or research method for their inquiry.

Table 32.2 lists examples of various health-related research questions and the possible methodologies to use.

RESEARCH TOPIC	POSSIBLE METHODS
Therapeutic interventions used in clinical practice	Systematic review of previously published research studies A randomized controlled trial A cohort study or a case-controlled study
The prevalence or frequency of a problem	Descriptive cross-sectional survey or census
The accuracy of a diagnosis or assessment	Systematic review of previously published research studies A randomized controlled trial A random sample or consecutive sample study
The causation, level of harm, or prognosis of a problem	Case-controlled study or cohort study
Assessment and character of a problem	Quantitative, observational method
Perceptions, attitudes, beliefs, values, and experiences	Various qualitative methods (e.g., phenomenology, grounded theory, ethnography, qualitative exploratory, historical research)
On-going cycles of action and change	Participatory action approach (action research)
Theory clarification and consensus development	Concept or discourse analyses Delphi technique

Table 32.2. Potential disaster health research topics and methodologies

Systematic Reviews and Meta-analysis

Systematic reviews and meta-analysis methods are useful to assess what has transpired and been reported in the literature. When there is a body of evidence large enough to establish consensus for best practice, reviews are useful in identifying those interventions that might work best in the response

stages of a disaster. However, in the field of disaster health care, there are no current examples of disaster-related, systematic reviews. Because each separate disaster situation brings with it a series of unique occurrences that are impossible to predict, the value of a systematic review and meta-analysis may be limited in disaster research. As the discipline matures, and the science grows, this, likely, will change. However, in this nascent period of scientific development of disaster health care, it may be necessary to look to different forums for research evidence. Although they provide weaker evidence than systematic reviews, general literature reviews can contribute to our understanding of disaster situations. For instance, Hughes *et al*'s⁴⁹ general review of the psychosocial response of nurses in promoting the psychosocial recovery of disaster victims provides some useful recommendations for practice.

Experimental/Quasi-experimental Studies

Rebmann¹⁰ recommends that case-control or pre-test/post-test experimental studies are best used to evaluate the relationship between process engagement and the related outcomes of knowledge and response plan content. She further states that this requires clear concept operationalization (see concept analysis later in this section), instrument development, and appropriate psychometric testing of any instrument's validity and reliability. Oflaz *et al*²¹ recently investigated the effects of both psychoeducational and psycho-pharmacological interventions on Turkish earthquake survivors using a quasi-experimental design involving three comparison groups to identify the effects of psychoeducation only, psychopharmacology only, and a combination of both interventions.

These research methods, while helpful in practice, are very difficult to implement in the field in real-time events; the implementation of strict control would be almost impossible. Even with the use of a quasi-experimental design, the related parameters of randomization and manipulation present dilemmas. This is part of the dilemma for disaster-based research. Bradt *et al*⁵⁰ note that research claims in disaster medicine tend to provide evidence that falls within the lower end of the NHMRC classification levels (i.e., Category IV) and that they also lack international consensus.

Descriptive Studies

Perhaps the most common form of the quantitative research method used in disaster-related research is the descriptive study and, in particular, survey designs. Tolomiczenko *et al*⁵¹ surveyed 300 healthcare professionals in a Canadian community hospital regarding how they would react and cope with a potential outbreak of Severe Acute Respiratory Syndrome (SARS). The findings were useful for preparedness planning for the eventuality of such an outbreak. Woerschling and Snyder²⁵ surveyed 594 El Salvadorian residents follow-

ing two major earthquakes in 2001. They assessed post-earthquake conditions related to health care and access to health care, as well as housing, food, sanitation, and water. Their findings advocate for greater community action efforts through public health awareness-raising to assist survivors to adapt.

Epidemiologic Studies

Epidemiologic research uses a structured set of principles and statistical methods to address questions concerning risk factors, surveillance, morbidity and mortality in human populations. This type of research can provide fundamental knowledge necessary to guide future research efforts, and assist in priority-setting and resource allocation during a disaster response.

Disaster epidemiology research can be strengthened by the collection of quantitative data and careful selection of the data points, or indicators, that should or could be collected during a disaster. Bradt *et al*⁵⁰ stress that epidemiological surveillance of disasters is enhanced by surveillance definitions relying on quantitative criteria. Disaster epidemiologic data are scant, in part because of the difficult environments in which data collectors would be required to work, and because, at least currently, there is a tendency for epidemiologists to focus on public health and population health issues.

Qualitative Research

Qualitative research is undertaken to gain insight or experience with complex and/or sensitive issues and can be very useful in formulating ideas for future investigation. Qualitative research is both exploratory and inductive, and is excellent for summarizing large amounts of data within the human context. In an older, but nevertheless useful study, Suserud and Haljamäe⁵² used interviews to evaluate the experiences of 16 Swedish nurses who were present at two different disaster sites; one being a “load and go” situation, and the other being a “play and stay” situation”. The study findings identified the need for more systematic training to support nurses in both of these situations.

O’Boyle *et al*²⁶ utilized focus groups to develop recommendations regarding interventions that would support the ability of nurses to work effectively during disaster relief response, and facilitate better communication and multidisciplinary collaboration. Recommendations based on their findings included specific measures to improve safety, reduce anxiety, increase trust in hospitals, and provide physical and emotional support for nurses. Nasrabadi *et al*²⁷ used focused, semi-structured interviews to explore Iranian nurses’ experiences in disaster relief following the Bam earthquake in 2003. Of the general themes that evolved from the study, the need for established team-working emerged strongly. Yuko *et al*⁵³ interviewed Japanese nurse survivors of the Hiroshima bombings in 1945. Their findings revealed the

mental attitudes needed by the survivors to cope with and work within such disaster environments.

Action Research

Action research, or participatory action research (PAR), is a method of research commonly used in assessing interventions and evaluating development and change within groups or communities. It is a common form of nursing research and focuses on the effects of the participants' actions within a community with the goal of improving some element of the services that support communities. Action research uses a systematic, cyclical process to plan, intervene, collect data, evaluate, and report prior to entering the next cycle with a modified or complementary intervention. The PAR is a problem-focused and context-specific approach that involves direct participation in a dynamic research process, while monitoring and evaluating the effects. Action research incorporates an on-going series of interventions followed by evaluation to progressively improve practice.

An obvious benefit to this approach is that anyone can be co-opted into the study (where participants are co-researchers also). This avoids the difficulties described by Scanlon,⁵⁴ of finding participant populations to study in mass-casualty incidents or "sampling an unknown universe". Other benefits of PAR are that the co-researchers can learn the nuances of the problem as the study progresses, and its action cycles ensure that situations are assessed, reflected on, and changed for the better as the research continues until the co-researchers agree that no more can be done or a different course of action is agreed upon. As potential longitudinal studies, the PAR method can incorporate all the phases of a disaster, including planning, relief, and recovery. Perhaps PAR's greatest strength is that it is a fluid and flexible mixed-methods design that can adjust to changing situations to adopt or reject differing methods for issues, such as data collection and data analysis techniques — as well as being able to incorporate elements of both qualitative and quantitative paradigms.

Triangulated Mixed Methods

Triangulation involves the use of several (mixed) methods to provide a more comprehensive answer to a research question. Data obtained from studies that use mixed methods often are richer than those obtained from studies using only a single research method. For example, a researcher may use focus groups *and* a literature review to gain an understanding of the issues in their area of research prior to distributing a survey that has been developed using the focus group data and the findings of prior research reported in the literature. To investigate the experiences of rescue nurses at the site of the 21 September 1999 Taiwan earthquake during their first 72 hours of relief response, Shih *et al*⁵⁵

used a cross-sectional triangulation design consisting of qualitative thematic analysis from semi-structured interviews accompanied by descriptive and inferential statistical methods. Chen *et al*²² used both descriptive survey and focus group methods to collect data from 113 adult Vietnamese residents of New Orleans who experienced Hurricane Katrina. Findings revealed a multitude of negative physical, psychological, and social (particularly financial) health consequences for these survivors.

Case Studies and Anecdotal Reports

A case study is a form of descriptive research that focuses on a single, often complex case. Case studies often are based on anecdotal reports by individuals of an event, such as a disaster. Generally, case studies do not investigate cause-effect relationships, but, rather, are exploratory and descriptive and aimed at improving our understanding of the characteristics of the case. Case studies and anecdotal reports can provide information regarding the experience of health-care workers responding to a disaster. The data often are predominantly qualitative and supplemented by descriptive statistical information concerning the event. These reports can be useful tools for education, although it is difficult to generalize the information obtained from a single case study of one event. The findings suffer from weaknesses in validity and reliability and, frequently, baseline data for comparison are lacking. Attempts to overcome these weaknesses include the use of structured approaches and multiple-case studies.

Concept and Discourse Analyses

Concept and discourse analysis are used widely in nursing research to identify underlying themes and issues, and to develop theory. Concept and discourse analyses are useful tools for fine-tuning the constructs and practices in which nurses are involved. Generally, these methods are employed in situations in which concepts are poorly defined or poorly researched. Many facets of disaster nursing fit these criteria, which is why a small body of publications exists using this approach. For example, Rebmman¹⁰ used concept analysis to help define bioterrorism preparedness for nurses. The author concluded, however, that further refinement and operationalization of the theoretical definition that emerged from the analysis are required. Nesmith⁵⁶ also used concept analysis to explore the term *disaster* and its implications for emergency nursing practice. She also suggests the need for further refinement of this term and a subsequent construction of a speculative framework for practice.

GAPS IN RESEARCH

Numerous gaps in current disaster-related research have been identified. Morrissey and Reser⁵ describe a lack of research on the specific factors associ-

ated with rural living and environmental threats as they relate to psychological distress. They recommend further research to evaluate interventions for ensuring community cooperation and improving community preparation. Bradt *et al*⁵⁰ suggest more clinical research that identifies gaps in the current international disaster management knowledge base, as well as the development of a repository of current pilot projects and research proposals in the field. Powers⁵⁷ highlights the lack of research data regarding the outcomes of disaster education and training for nurses, and suggests that there is no established standard or tool with which to evaluate the outcomes. Several other authors have identified the need for research regarding the outcomes of disaster preparedness and response exercises for nurses.^{58–59}

Some of the existing gaps in disaster research information may be understandable. For instance, from 1991–2000, approximately 242 million people died or were profoundly affected by disasters and conflicts worldwide.⁵⁰ However, during this same time period, not one person died or was affected by a disaster in New Zealand. Nonetheless, disaster preparedness is relevant in New Zealand, which lies on an extensive series of active volcanoes associated with a major earthquake fault line. Having recently experienced a disaster is a strong motivator for governments to fund disaster research and, as a result, research may be patchy or scant in areas unaffected by a recent disaster.

CONCLUSION

Research in the field of disaster health care is growing rapidly. Ever-increasing, large-scale disasters, such as those that occurred with the Indian Ocean tsunami, the Myanmar cyclone, and the 2008 China earthquake, dictate that we learn lessons from such catastrophic situations to assist us in future planning, relief-response and recovery efforts. Disaster research is not without dilemmas, however. Ethically, practically, and scientifically, research in this area is complex, challenging and difficult. There are large gaps in our evidence-based knowledge. Of the UK National Health Service disaster response provision, Hayward⁶⁰ says:

there are many issues around lack of vision and strategy in a chaotic and poorly managed disaster response plan existing at all levels of the UK framework.

If this viewpoint is correct and representative of the international condition, it emphasizes the considerable need for further research to aid and assist essential change and reform. Some research and evidence-based methods are tried and tested, although few are established, and even fewer are well-evaluated in terms of effectiveness. Most research in this field is conducted either in the pre-event or recovery phases, leaving a large gap in our knowledge of

the relief phase of a disaster. Nurses should discard any hesitation to perform scientific research, and should gather the skills necessary to critique research papers, support those nurses who design and conduct research, access best evidence, and use it to change practice. By supporting disaster research, nurses contribute to the knowledge needed to make sound clinical judgments and decisions promote understanding of the complexity of nursing practice; provide the basis for expanding disaster scientific knowledge and link education, theory, and practice.

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CHAPTER 33

DISASTER RESEARCH FRAMEWORK

Elaine Daily

IN RESPONSE TO THE NEED for the discipline of disaster health to build its science on data that may be generalizable and comparable, the Task Force on Quality Control of Disaster Management and the World Association for Disaster and Emergency Medicine have created a framework for the structure of disaster research and evaluation.¹ This framework is conceptual and based on the consensus of experts from these groups regarding the mechanisms of a disaster and their relationships to the health status of the affected people. In congruence with the conceptual model, relationships are broken down and simplified in order to describe the interactions and determine underlying evidence. As with all conceptual models, it is a dynamic framework, open to challenge and change as new evidence is gleaned. Although the conceptual disaster framework may be useful to other disciplines, it was created specifically for the study of the health aspects associated with a disaster.

OBJECTIVES:

- Differentiate between the terms *hazard*, *event*, *damage*, *loss of function*, and *disaster*;
- Describe the progressive phases of a disaster using a longitudinal framework;
- Understand the 13 basic functional systems within a society; and
- Identify the eight phases or elements used in reporting, evaluating, and analyzing any component(s) of a disaster, regardless of type or duration.

Critical to this framework is the inclusion of standardized definitions of the terms used to describe factors that lead to and affect the occurrence and severity of a disaster. Figure 33.1 identifies the progression of the occurrences that lead to a disaster, beginning with a *hazard* that becomes an *event*, that causes *damage* and *decreased or loss of function*, that lead to a *disaster*.

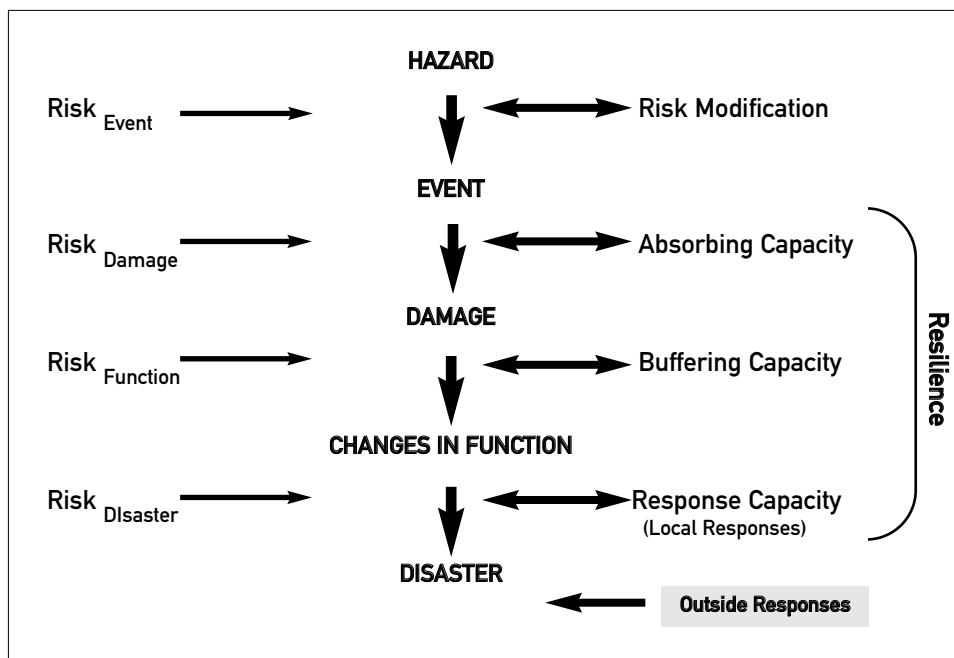


Figure 33.1: The progression of the elements that lead to a disaster and the elements that affect the risks of occurrence

HAZARD

A *hazard* is anything that poses a danger or threat. Hazards may be natural or man-made, or a combination of both. Natural hazards are classified as seismic (or geophysical), climatic, meteorological, hydrological, or biological. Table 33.1 lists some examples of each of these hazards that exist in nature. Man-made, or anthropogenic UCMs, may be classified as technological or related to people's potential for conflict. And some hazards, such as poorly constructed buildings along with existing seismic activity, represent a combination of natural and man-made hazards.

EVENT

An *event* is the actualization of a hazard; it is the release of energy that has the potential to negatively affect living things and/or the environment.¹ Events may be caused by natural or man-made hazards, or from a combination of the two (Table 33.1). For example, the severe rainstorm (an event related to a natural hazard) that occurred in Nicaragua caused mudslides related to deforestation (a man-made hazard).

An event also may be *primary*, i.e., the event responsible for initiating the damage, or it may be *secondary*, i.e., an event triggered by the primary event. An example of this is the occurrence of the Adaman-Sumatra earthquake (the primary event) in Southeast Asia in 2004 that triggered the

HAZARD	EVENT
Natural Geophysical or Seismic	Earthquake Tsunami Volcano Avalanche Landslide
Climatic	Extreme temperatures Drought Wildfire Desertification
Meteorological	Storm Hurricane Cyclone Tornado
Hydrological	Flood Storm surge Mudslide
Biological	Epidemic Insect infestation
Anthropogenic Technological	Chemical spill Radiation Explosion Gas leak Building collapse Fire Transportation accident (road, air, rail)
Conflict potential	War Terrorism
Combination	Embargo Earthquake and gas leak Wildfire and explosion Storm and landslide from deforestation Epidemic

Table 33.1. Natural and man-made hazards and associated events

tsunami (the secondary event) in the Indian Ocean. Events are characterized not only by their causative hazard, but, also, according to their type of onset (sudden, gradual, or slow), their duration (brief, short, intermediate, or prolonged), and their scope. The scope of an event refers to: (1) its amplitude or strength (e.g., storm surge height, Richter scale measurement); (2) its intensity or amplitude over time (e.g., rainfall per hour); (3) its scale or

intensity in an area (e.g., number of hectares flooded); and (4) its magnitude, or total energy of the event plus the duration of the event (e.g., the total amount of rainfall in an area from a storm).

The term *event* is most commonly confused in disaster reporting, and frequently and erroneously is referred to as the disaster. However, the event is *not* the disaster and may never even cause a disaster. Clearly identifying the event, or events, that resulted in a disaster is essential to making comparisons between events and discerning those commonalities that may exist in many or all events.

The probability that a hazard will become an event may be reduced through human actions to modify the risks associated with that hazard. The likelihood that a hazard will become an event depends on the natural vulnerability (i.e., the vulnerability determined by nature) as well as the vulnerability of the society as a result of human actions. While *risk modification* to reduce the probability of an event is possible for the anthropogenic hazards, few natural hazards are amenable to modifying their risk of occurrence.

DAMAGE

Damage is the harm or injury an event causes to structures, living and man-made, and/or the environment. Damage impairs the value or usefulness of something; it is the negative consequences of the energy released by the event.¹ The physical collapse of buildings or bridges, or the injuries sustained by victims of an event are examples of damage. Some damage may be repairable and some irreparable. Just as not all hazards cause an event, not all events cause damage. And as with an event, the occurrence of damage does not necessarily result in a disaster.

The probability that an event will result in damage is determined not only by the amount of energy released by the event, but, also, by the capacity of the affected society (its environment, living beings, structures, and infrastructures) to absorb that energy. This is referred to as the *absorbing capacity* and may be modified (increased or decreased) by human actions. For example, constructing buildings with quake-resistant materials increases the *absorbing capacity* for the energy released by an earthquake, while extensive logging and deforestation may decrease the *absorbing capacity* for the energy released by heavy rains.

CHANGE IN FUNCTION

The damage to some structure or the environment that resulted from an event may impair the *function* of that structure. The resultant change may be a decrease in the level of function, or a total loss of function. For example, a broken pipe (damage) may lead to a loss of water supply (decreased function), causing some functions of the organizational structure of the society to be

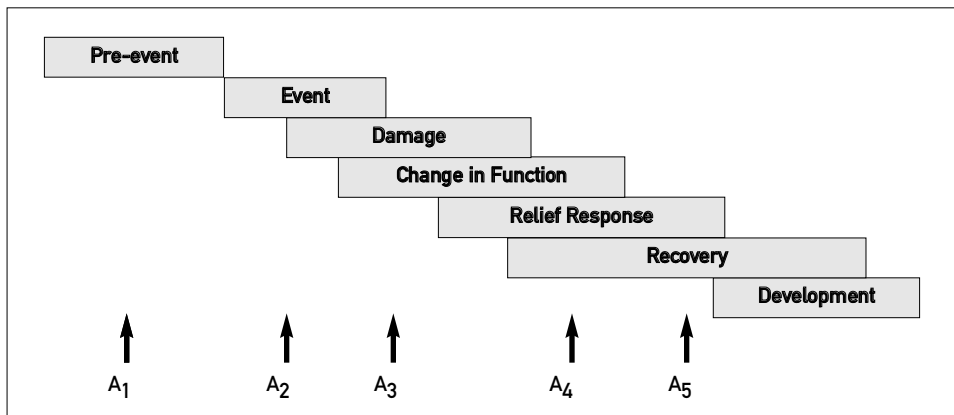


Figure 33.2: The longitudinal phases of a disaster in order of chronological appearance. Some phases may extend over long periods of time and overlap with other phases. Thus, the phases are identified by properties rather than time. Assessments (A) can be made and repeated at any time during any and all of these phases, but the results always are related to the pre-event and pre-intervention assessments.

diminished. Or, the collapse of a bridge (damage) may lead to the loss, at least temporarily, of the means of transportation of people, goods, and services; it alters the functioning of the society. Not all damage created by an event leads to a change in function; if no change in function occurs, no disaster occurs.

The probability that a change in function will result from the damage caused by an event is determined by the extent of the damage and the ability of the affected society to cope with that damage and to continue to function despite a change in available resources. This ability is referred to as the *buffering capacity* of the society and can be modified (increased or decreased) by human actions. For example, the stockpiling of drugs and medical supplies increases the *buffering capacity* for the damage resulting from an epidemic, while locating generators in the basement of hospitals decreases the *buffering capacity* for the damage resulting from flooding. The stockpiling of drugs may allow the healthcare system to remain functional during an epidemic while generators placed in the basement of the hospital are likely to be damaged by flooding rendering the hospital only partially functional, or completely non-functional.

DISASTER

A *disaster* occurs when there is serious disruption of the *functioning* of a society, with widespread human, material, and/or environmental losses that exceed the ability of an affected society to cope using its own resources.¹ A disaster always requires outside assistance, whether that outside assistance comes from a neighboring community, county, state, province, territory, or country. Thus, the affected society's ability to cope with or manage the change or loss in function that resulted from the damage caused by an event will determine whether or not a disaster occurs. The overwhelming change(s) in function that cause a disaster in one society may be manageable by another society and not result in a disaster.

BASIC SOCIETAL FUNCTIONAL SYSTEM	FUNCTIONS/RESPONSIBILITIES
Public health	The health status of a population of people
Medical care	The medical treatment and health care of individual patients, including primary, secondary, and tertiary care, and psychological care
Water and sanitation	The provision of adequate supplies of uncontaminated water and the collection, evacuation, and disposal of wastes
Shelter and clothing	The provision of protection against harmful environmental elements
Food and nutrition	The provision of necessary nutrition, including health standards to prevent and treat nutritional diseases
Energy supply	The provision of energy required to keep the technical aspects of the society functional, including electricity and fuel
Public work and engineering	The development and maintenance of the infrastructure and all physical structures (railroads, roads, buildings, etc.)
Social	The relationships within a group of people (social and governmental systems, cultural practices, living conditions, etc.)
Logistics and transport	The transport and evacuation of persons, equipment, and supplies, both public and private (subways, trains, buses, automobiles, boats, ships, etc.)
Security	The security and safety of the population
Communications	The interchange of information between all public and private facilities (fire, police, television, radio, telephone, newspapers, Internet, etc.)
Economy	The provision of the resources necessary for societal function (agriculture, crops, industry, jobs, trade, income, etc.)
Education	The education and training of the citizens of the society including necessary resources (teachers, libraries, schools, equipment, etc.)

Table 33.2: Basic Societal Functional Systems and their primary functions and responsibilities¹

THE LONGITUDINAL DISASTER FRAMEWORK

The chronological progressive phases of a disaster are deconstructed longitudinally in order of their appearance in time, even though some of them may occur concurrently. For the purposes of studying disasters, and for interpreting, understanding, and comparing the findings of such studies, it is imperative to distinguish each of the phases of a disaster. These phases are identified by their properties rather than by a time component.

Figure 33.2 depicts these phases, which include: (1) the *pre-event* phase; (2) the *event*; (3) the *damage*; (4) the *change in function*; (5) the *relief response* phase; (6) the *recovery* phase; and (7) the *development* phase. The *relief response* phase includes all interventions to alleviate the pain or suffering of the affected society. The *recovery* phase incorporates those interventions that are not directed towards life-saving or relief efforts, but, rather, toward restoration of the societal functions to their pre-event state. When the pre-event state is

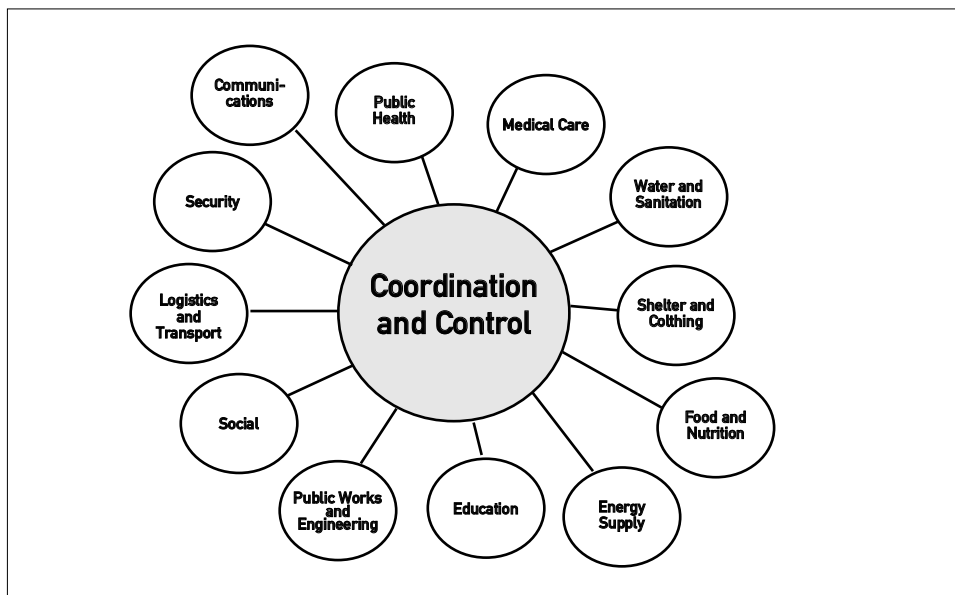


Figure 33.3: Deconstruction of the components of a society according to Basic Societal Functional Systems with management by Coordination and Control

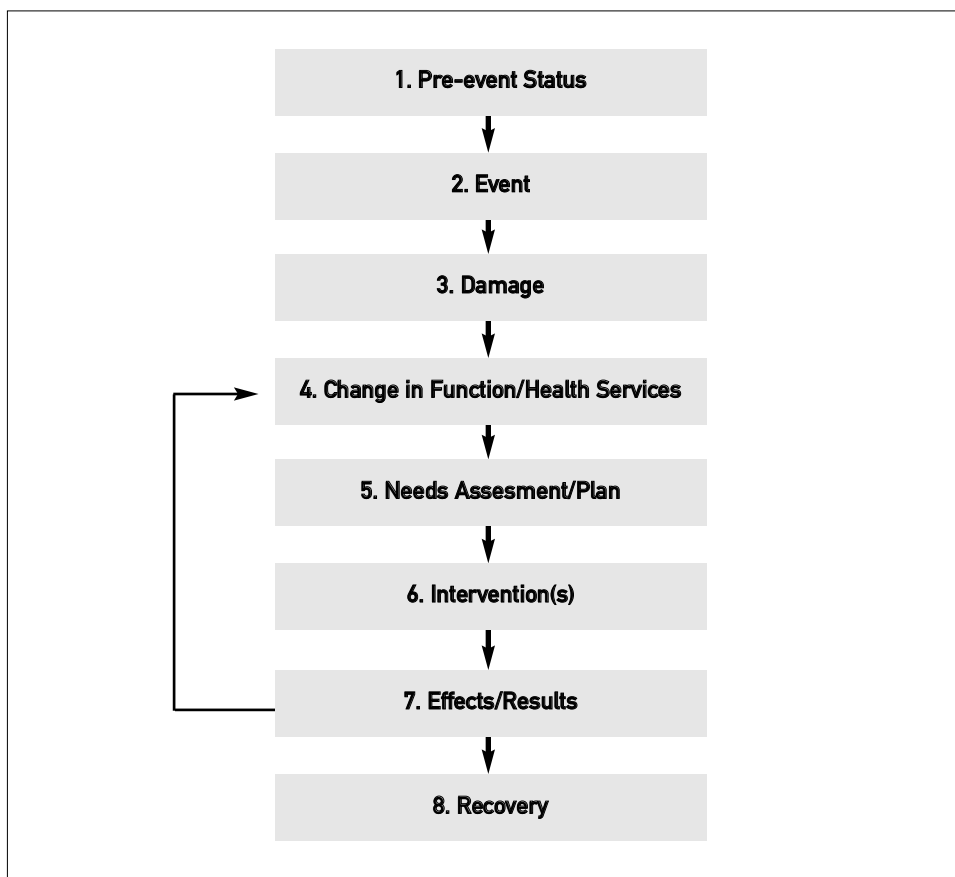


Figure 33.4: The phases/elements of the Disaster Research/Evaluation Template related to health

restored, recovery is complete, and the disaster is over. The development phase includes those interventions and actions that improve one or more of the societal functions to a higher level than it was before the event. Thus, preparedness and mitigation efforts are part of development as they improve the society's ability to withstand a future event.

THE TRANSECTIONAL SOCIETAL FRAMEWORK

The damage, changes in function, and the disaster that occur following an event are relevant only in terms of their impact on a society's population, constructions, functions, or environment. In order to study and compare the effects of a disaster on the complex amalgam that constitutes a society, the Task Force on Quality Control of Disaster Management has organized, or transected, the society into 13 functional systems or components,¹ in much the same way that the human body is organized by functional organ systems for purposes of clinical assessment. These functional descriptors are generic, exist in some form or another in virtually all societies, and are referred to as *Basic Societal Functional Systems* (BSFS) (Table 33.2).

All of these BSFS should be the responsibility of a Coordination and Control agency, as depicted in Figure 33.3. Each of the BSFSs consists of multiple functions and subfunctions, and most are dependent upon one or more functions of other BSFSs to remain operational. For example, Medical Care depends on Education for the training of personnel, and Transportation for the transport of patients, staff and supplies; and virtually all of the BSFSs, are dependent on Energy Supply. However, for the purposes of analysis and research, it is necessary to categorize or assign functions to only one BSFS, using the same indicators of function with each assessment. This allows evaluations to be repeated and findings to be compared between evaluations, between societies, and between disasters.

THE DISASTER HEALTH RESEARCH TEMPLATE

The deconstruction of the phases of a disaster for purposes of analysis have been modified and expanded slightly for the specific study of the health aspects related to a disaster. The seven chronological, longitudinal phases of a disaster depicted in Figure 33.2, are expanded to eight elements to include the assessment process in the revised Disaster Health Research Template.¹ This template provides structure for the design, implementation and reporting of evaluations of disaster responses, relief responses, preparedness activities, mitigation efforts, and population vulnerability specifically related to the health aspects of a population. Figure 33.4 identifies the phases/elements that are necessary to describe any component of a disaster. These phases include:

1. The pre-event status;
2. The event responsible for the disaster;
3. The damage produced by the event;
4. The functional change or disturbance in health produced by the damage;
5. The assessment of the needs and formulation of plans;
6. The interventions provided;
7. The assessed results of the interventions in terms of effectiveness, efficiency, costs and benefits; and
8. The recovery or restoration of the health status.

Pre-event Status

The pre-event status serves as the baseline for the determination of damage and disturbances in function from an event. It also determines when the disaster is over, as this is defined as the return to the pre-event status. A useful, clinical analogy is that of some damage to one of the organ systems within the human body that leads to a change in function that may place the individual in peril. We use the individual's baseline status to assess the severity of the change, and we intervene to return the individual to their baseline status. This requires knowledge of the patient's history, or baseline. Similarly, knowledge of the pre-event status of the population or of any of the Basic Societal Functional Systems is essential in all disaster management and evaluations. Although this baseline information often is fragmented, it ideally should be compiled before a disaster occurs.

Event

Clearly identifying the disaster-producing event according to its causative hazard and its onset, duration and scope, as well as its primary or secondary nature, is important in studying and reporting disasters. Included with descriptions of the event should be any risk modification efforts that had been undertaken to reduce the probability of the occurrence of the event.

Damage

In terms of health-related evaluations, the damage caused by an event may be determined by assessing the associated morbidity (injuries and illnesses, including psychological) and mortality of the population affected, and/or by assessing any of the structures or environmental components that could relate to health or health care. The overall assessment of the extent of damage produced by an event is determined by the pre-event status and is related to the characteristics of the event and to the absorbing capacity of the society. Thus, descriptions of the damage should include all the contributing factors (i.e., absorbing capacity), both

natural or man-made. This information is essential to allow comparisons of damage from similar events in different societies as well as comparison of damage from dissimilar events in the same society, and for the determination of which factors may be important in terms of disaster mitigation.

Disturbances in Function or Health Status

Assessing the disturbances in the health status of an affected population involves determining changes in functionality of any of the components of the Medical Care or Public Health BSFSs. Descriptions of changes in the health status of the population should include all factors that may have altered the buffering capacity of the affected society to withstand the damage incurred. Any determinants of changes in health status only can be made when related to the pre-event health status.

Needs Assessment and Plan

All interventions involved in a disaster should be based on an assessment and identification of needs that define the resources or actions required for the restoration of a function, or of the health status, to its pre-event state. Assessments and identification of needs should be repeated frequently during a disaster to provide an overview of the existing conditions, which can change quickly and frequently, as well as after every intervention to determine whether or not the intervention was successful in meeting its objective(s), and whether or not unanticipated consequences occurred. It is essential that all the assessments performed in a disaster utilize the same indicators of function, and that these indicators are used in any related reports. Several assessment tools have been developed for use in disaster situations.²⁻⁵

From the identified needs, a plan of action is developed to meet the identified needs. All planned interventions must have explicitly stated goals or objectives. For health-related interventions, these goals should address a change or changes in some aspect of the health status of the affected society and should be elucidated in all reports and publications of disaster-related interventions.

Interventions

Interventions are the actions undertaken to meet the needs identified through the needs assessment process. Interventions may occur during any phase of a disaster.

Effects

As improvement in some aspect of the health status is the goal of every health-related intervention, every intervention must be evaluated in terms of

its effectiveness in meeting the stated goal(s). In addition, the efficiency of the process(es) with which the intervention was carried out, and the associated costs and benefits should be reported. In describing the consequences of any intervention, it is imperative to include the results of the assessments made both before and after the intervention, to use the same indicators of function, and to identify in which phase of the disaster the assessment(s) was performed. Each assessment not only is compared to the pre-event assessment, but, also, to all other assessments previously conducted. This provides a dynamic picture of the health status of the affected society, reveals the effects of an intervention(s), and identifies any new or additional needs.

Recovery/Restored Health Status

Repeated assessments using the same indicators of function are used to determine whether or not an intervention or set of interventions have returned the health status of the afflicted population to its pre-event state. If the pre-event status has been achieved, and the health status has been restored according to the indicators used, recovery of that Basic Societal Function has been achieved. The disaster is over when all Basic Societal Functions have been restored to their pre-event status. If the pre-event status has not been reached, new assessments are performed to determine the need for new or additional interventions. This process is repeated until the health status is restored. Restoring the health status of a population to a level that is better than their pre-event state is referred to as *Development*.

USING THE DISASTER RESEARCH FRAMEWORK

While the proposed research framework provides a structure for evaluation and reporting of the health aspects related to a disaster, it may be adapted for use in studying other aspects of a disaster. Likewise, it can be used employing various research methodologies as well as in prospective and retrospective analyses. The following example of a health-related study is provided to illustrate the application of the framework in disaster health.

Example 1

In this hypothetical example, the disaster being studied is caused by a wildfire.

1. Identify the question or hypothesis.

Example: What is the effectiveness of an intervention to provide potable water to the affected community?

2. What was the pre-event status?

Example: From utility records determine the average daily consumption of water per person per day prior to the event.

3. What was the event?

Example: Describe the wildfire event in terms of the hazard that caused it, its onset and duration, and its scope. Include any risk modification efforts that may have been undertaken, such as fire prevention and control programs.

4. What was the damage from the event?

Example: Describe overall damage as well as specific damage to the structure(s) related to the intervention being studied. In this case, it would be damage to the water supply system. Include descriptions of any actions that had been taken to increase the absorbing capacity, such as measures to protect the water supply system.

5. What was the loss of function and how was it assessed?

Example: Compare current water consumption to the pre-wildfire water consumption as determined by utility company records and cluster neighborhood sampling. Determine any health effects in terms of morbidity and mortality from information obtained from healthcare providers; compare to pre-wildfire information. Include descriptions of any actions that had been taken to increase the buffering capacity, such as backup water supply systems (on an individual or community level), and community education efforts.

6. What was the result of the assessment, what needs were identified, and what plans were formulated?

Example: Describe the assessment tool used, how the information was obtained, which indicators of function were used, and when the assessment occurred. Detail the identified needs and the planned intervention to meet these needs. In this case, the identified need was for a sufficient supply of potable water to meet the basic functional threshold level determined to be 5L/person/day in these conditions. The plan was to provide an outside source of water via delivery trucks to affected neighborhoods.

7. What was the intervention?

Example: Describe in detail the intervention provided, including who provided the intervention, how, when, where, and to whom it was provided, as well as any pre-existing arrangements that may have facilitated the intervention. In this example, an outside water delivery company was contracted to supply potable water to the community in the amounts indicated through a pre-arranged memorandum of understanding.

8. What were the effects of the intervention?

Example: Describe the effects of the intervention, in terms of meeting its goal, how efficiently the goal was met, the costs of the intervention, the benefits of the intervention, and any unanticipated effects that occurred as a result of the intervention. In this example, the outside delivery of potable water resulted in members of each family having 5 liters/day of potable water as determined from cluster neighborhood surveys. Encumbrances encountered in the delivery and receipt of the water by each family diminished the efficiency of this system. The benefits related to changes in the health status of the population were obtained by comparing information provided by healthcare providers before the event, after the event but before the intervention, and after the intervention. The costs of the intervention were obtained from the delivery company.

9. Did the population recover or was the health status restored?

Example: Describe the results of repeated assessments using the same indicators of function and compare them to the pre-event status to determine if recovery has occurred. In this example, the intervention studied restored the functional status related to the quantity of potable water as determined by repeated assessments.

Example 2

This next example focuses on an intervention program to reduce the incidence of influenza in a community affected by an influenza epidemic.

1. Identify the question or hypothesis.

Example: What is the effectiveness of a school nurse surveillance and hand-washing educational program for elementary school children on school absenteeism due to influenza-type illness?

2. What was the pre-event status?

Example: From school records, determine the average daily absentee rate prior to the event and the intervention and, from a brief survey, determine pre-intervention hand-washing practices.

3. What was the event?

Example: Describe the epidemic event in terms of cause, its onset and duration, and its scope. Include any risk modification efforts that may have been undertaken, such as community education programs, etc.

4. What was the damage from the event?

Example: Describe the damage in terms of numbers of individuals with flu-like symptoms. Include descriptions of any actions that had been taken to increase the absorbing capacity, such as

social distancing, barriers employed, working at home, community education programs, and prophylactic immunizations, etc.

5. What was the loss of function and how was it assessed?

Example: Compare school absentee records in terms of numbers of people and numbers of days absent before and after the event. Determine morbidity, mortality, and hospitalization admissions from information obtained from healthcare providers; compare to pre-event information. Include descriptions of any actions that had been taken to increase the buffering capacity, such as community education efforts, etc.

6. What was the result of the assessment, what needs were identified, and what plans were formulated?

Example: Describe the assessment tool used, how the information was obtained, which indicators of function were used, and when the assessment occurred. In this case, the assessment consisted of observation of current handwashing techniques and a brief self-reporting survey of current hand-washing practices. The plan was to provide a weekly education and video program to all school children stressing the importance of proper hand-washing techniques, and to have the school nurses visit each classroom each day to assess, overall, the children's health, and to contact the family of each absent child to document the reason for the absence.

7. What was the intervention?

Example: Describe in detail the intervention provided, including who provided the intervention, how, when, where, and to whom it was provided as well as any pre-existing arrangements that may have facilitated the intervention. In this example, a video and an educational program were presented weekly to all elementary school children and a daily health surveillance program was instituted by the school nurses.

8. What were the effects of the intervention?

Example: Describe the effects of the intervention in terms of meeting its goal, how efficiently the goal was met, the costs of the intervention, the benefits of the intervention, and any unanticipated effects that occurred as a result of the intervention. In this example, rates of absenteeism were compared to schools in other districts without these interventions. The increased surveillance by the school nurses revealed other, non-flu related issues that were dealt with by the nurses and provided early

identification of symptomatic students. The costs of the intervention included the costs of the educational program and the increased nursing personnel costs.

9. Did the population recover or was the health status restored?

Example: In this example, the intervention was prophylactic and not directed at restoration or recovery.

CONCLUSION

Using a structured framework with clearly defined terminology facilitates the development of a sound body of evidence regarding the factors that influence the health status of a population affected by a disaster. *The Health Disaster Management Guidelines for Evaluation and Research in the Utstein Style*¹ provides a conceptual approach for use in the study of the health aspects related to a disaster. Such an approach allows comparisons to be made between evaluations, between different societies, and between different disasters. The conceptual disaster framework is dynamic and open to challenge and change as experience and evidence are obtained, but affords the initial structure to obtain data to build the science of disaster health.

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INDEX

A

- AARs *see* After Action Reviews
- Absorbing Capacity 586, 591–2, 594, 595–6
- acceleration/deceleration 255
- Access Overload Control (ACCOLC) 109
- accreditation 129
- action plans 140, 144, 145
- action research 577
- acute care 153, 346
- acute local radiation injury 241, 242
- acute radiation syndrome (ARS) 228, 240–4
- Acute Respiratory Infections (ARIs) 432, 433, 435–6, 438
- acute stress disorder (ASD) 456
- ADA *see* Americans with Disabilities Act
- Adamsite 193
- adaptability/adaptation 6–7, 10
- administration and finance section (of HICS) 173
- administrative/organizational vulnerability 18
- Advanced Life Support (ALS) 42–4, 382–3
- advocacy agencies (special needs) 297–300, 501–2, 539–42
- aerosolization 185, 201, 203, 207, 208, 231, 308–9, 399
- AFRRI *see* Armed Forces Radiobiology Research Institute
- After Action Reviews (AARs) 24, 25, 380, 536
- Agency for Healthcare Research and Quality (AHRQ) 88, 97, 324, 553
- Agent BZ 192
- AHRQ *see* Agency for Healthcare Research and Quality
- air embolism 261–2
- ‘air hunger’ 191
- Air-Purifying Respirator (APR) 277, 278
- Air Self-Defense Force (Japan) 367, 368
- aircraft (transportation) 159–60
- ‘Airwave’ technology 110–11
- airway management (skill) 43, 52, 59, 65, 261, 432
- ALARA (As Low As Reasonably Achievable) 231, 235
- alcohol problems 461
- algorithms (triage) 64, 67, 68, 69–70, 76
- ‘all call’ disaster notification 82
- ‘all-hazards’ disaster planning approach 15, 20, 26, 131, 326–7
- alpha particles 223
- ALS *see* Advanced Life Support
- alternate care areas 114–15, 123, 207–8, 410
- altruism 477, 481
- Alzheimer’s Association 295
- Ambulance Officers (EMS title) 42
- ambulance services 42–9
- ambulances (transportation) 159, 327–8
- American Academy of Pediatrics 297
- American Association of Colleges of Nursing 550
- American Association of Retired Persons 297
- American Medical Association (AMA) 481, 482, 555
- American Nurses Association (ANA) 324, 478, 484, 487, 549–50
- American Red Cross 135, 550, 556
- American Veterinary Medicine Association (AVMA) 293–4
- Americans with Disabilities Act (ADA) 292–3
- ANA *see* American Nurses Association
- anecdotal reports (research approach) 578
- Angel One air transport 540
- anthrax 200–1, 203, 206, 209, 216, 273, 392
- anthropogenic hazards 584, 585
- antiemetics 243, 247
- antiviral agents 411–13
- APR *see* Air-Purifying Respirator
- APTR *see* Association for Prevention Teaching and Research
- arenaviruses 216
- ARIs *see* Acute Respiratory Infections
- Arkansas Children’s Hospital 540
- Armed Forces Radiobiology Research Institute (AFRRI) 244
- ARS *see* acute radiation syndrome
- ASD *see* acute stress disorder
- assembly points 156
- assessment dependency grid (electricity) 145
- assessments (public health role) 385–6
- asset distribution 227–8
- Association for Healthcare Resource and Materials Management 88
- Association for Prevention Teaching and Research (APTR) 553
- Association of Teachers of Preventive Medicine 550
- assurance (public health role) 387
- AtroPen 318
- Atropine 187, 188
- AusAID 358
- austere care 133–4
- Australasian Triage Scale 72
- Australian disaster medical teams 526
- autonomy principle 476–7, 483
- avian influenza 399, 401, 414, 420–1, 563
- AVMA *see* American Veterinary Medicine Association

B

- BAL *see* British anti-lewisite
- ballistic trauma 258
- Bam earthquake [case study] 355
- Basic Life Support (BLS) 42–4, 382–3
- Basic Societal Functional systems (BSFS) 586–7, 589, 590, 591, 593
- bed space 114–15, 122, 211
- behavior
 - behavioral responses of children 310–11
 - collective behavior 34
 - convergence behavior 35–6, 37
 - informal responses — organizational behaviors 33–5
- behavioral responses (to stress) 452–3
- beneficence principle 132–3, 476, 483
- bereavement 460
- Beslan school siege 308
- beta particles 223
- bioethics 474, 485
- biological agents 299–313, 216–20, 273
- biological contamination 150, 203–5
- biological events 203–5, 394
- biological preparedness 199–213, 216–20
- bioterrorism 200, 203–5, 253, 377–8, 379–80
 - category A agents 216–17

INDEX

- category B agents 217–18
 - category C agents 218
 - contingency plans 383
 - signals/triggers 204–5
 - see also* terrorism
 - Bioterrorism Response Education program 562
 - biotoxin 203, 211, 218
 - blast injuries 255–61
 - Blast Lung Injury (BLI) 256
 - bleach solution 267, 275
 - blindness (xerophthalmia) 433
 - blister agents 188–90
 - blood banks 88
 - blood chemistry analysis 52
 - blood gases 191–2
 - blood products 88, 133, 243, 244
 - BLS *see* Basic Life Support
 - boat/ship (transportation) 160
 - Body Mass Index (BMI) 440
 - bombings/bomb threats 90, 147–8
 - dirty bombs 226
 - London Bombings 77, 109, 113, 123, 262
 - Madrid Bombings 83, 90, 308
 - Oklahoma City Bombing 106–7, 308, 309, 339–40
 - 2002 Bali Bombings 107, 113, 116, 563
 - 'Bombings: Injury Patterns and Care' [educational program] 90
 - boreholes (water) 146–7
 - botulism 201, 216
 - Braille 301
 - branches (ICS/HICS) 169, 172
 - British anti-lewisite (BAL) 190
 - BSFS *see* Basic Societal Functional systems
 - Buffering Capacity 17, 120–8, 587, 594, 596
 - burn injuries 113–14, 260–1
 - burn units 113–14
 - buses (transportation) 159
 - business continuity 172
- C**
- calm (characteristic) 463
 - Canadian Triage and Acuity Scale 73
 - capacity building 120–8
 - capillary refill time 65, 68
 - capital (human, physical and social) 35
 - cardiac monitoring (skill) 43
 - care
 - altered practices of care 133–4
 - alternate care areas 114–15, 123, 207–8, 410
 - and children in disasters 313–15
 - critical care 113–14, 219–20
 - definitive medical care 354
 - mass care 328–9
 - supportive care 432
 - Careflight Triage System 67
 - Case Definitions for Infectious Diseases under Public Health Surveillance* [report] 390
 - case studies (research approach) 578
 - casualty 4, 24, 44, 62, 81, 376
 - burn casualties 113–14
 - casualty collecting point(s) sector 46
 - transporting casualties 63
 - and triage 57–77
 - unpredictable casualty estimates 405
 - victim arrival at the ED 83
 - see also* Mass-Casualty Incident
 - Casualty Clearing Areas 62
 - CBL *see* Cytogenetic Biodosimetry Laboratory
 - CBRNE events 170
 - CBT *see* cognitive behavioral therapy
 - CCRF *see* Commissioned Corps Readiness Force
 - CCTV *see* Closed Circuit Television
 - cellular sensitivity (to radiation) 240–1
 - Center for Health Policy-Columbia University School of Nursing 553
 - Centers for Disease Control and Prevention (CDC) 205, 206, 246, 247, 252, 358, 388–9, 535–6
 - and bioterrorism agents 200
 - Central Control Contact 148
 - Central Disaster Prevention Council 366
 - Central Operation Center 378
 - Central Reporting Contact 147
 - Centre for Research on the Epidemiology of Disaster (CRED) 565
 - cerebrovascular/central nervous system syndrome 241, 242
 - change in function 586–7, 588–90
 - Charity Hospital 531, 538
 - chemicals
 - agents 186–93, 200
 - blood gases 191–2
 - chemical exposure 185, 272–3
 - chemical hotlines 194
 - chemical MCIs — contingency plans 382–3
 - chemical preparedness and response 183–97
 - chemical spills and evacuation 150
 - disabling chemicals 192–3
 - lewisite 189–9
 - lung irritants 190–1
 - mustard gas 188–9
 - physical forms of chemical agents 185
 - as preservatives 110
 - systemic poisons 186–90
 - tissue irritants 190–2
 - child protection centers 316
 - childhood traumatic grief (CTG) 460
 - children, disasters and 307–19
 - care 313–15
 - common responses to disasters among children and adolescents 459
 - housing, clothing, and warmth 316–17
 - and Hurricane Katrina 540–2
 - management of disasters 319
 - medications for pediatric victims of weapons of mass destruction 317–18
 - mental health needs of children and young people 465–6
 - pediatric hospital supplies 317
 - physical vulnerabilities 308–9
 - planning section chief (ICS) 168, 311–12
 - psychological and/or behavioral responses 310–11
 - and Southeast Asia tsunami 515, 519, 523
 - tracking 315
 - triage 312–13
 - US federal pediatric resources 318
 - see also* pediatrics
 - chlorination techniques 147
 - chlorine 190–1, 193
 - CHN *see* Community Health Nurse
 - cholera 389, 427, 432, 434, 435, 438, 518
 - circulatory status 66
 - CISM *see* Critical Incident Stress Management
 - citizen band (CB) radios 82–3
 - Citizen Corps 36

- Civil Contingencies Secretariat 53
 clinical dosimetry 243
 Closed Circuit Television (CCTV) 103
 CMR *see* crude mortality rate
 CMV *see* cytomegalovirus (CMV)
 'CNN factor' 360
 Cochrane Collaboration 565, 571
 Cochrane Prehospital and Emergency Health site 571
 Code of Ethics 478
 cognitive behavioral therapy (CBT) 458–9
 cognitive responses (to stress) 452–3
 cold storage sites 116
 cold zone (decontamination) 276
 collective behavior 34
 combination team (decontamination) 269
 command post (sector) 46
 Commissioned Corps Readiness Force (CCRF) 347, 535–6
 communications 48–9, 106–11, 381, 501
 barriers to information and communication 299–301
 communication issues and radiation treatment 248
 communications resources 305–6
 disaster communication strategies 101–5
 ED notification of disaster 82–3
 impact on medical infrastructure from Hurricane Katrina 532
 information communication technology 101–2
 and lifelines 130
 media and information provision 105–6
 positive and respectful communication skills 489–90
 psychosocial and communication issues — internal contamination treatment 248
 public relations 134–5
 research related to health system communication and collaboration 564–5
 and security staff 92
 two-way radio communication 109, 111, 130
 community
 barriers to information and communication — community 299–301
 building a cohesive community 483
 caring for the community during disaster 3–4, 25
 community drills 23
 community evacuation behavior 30–7
 community HVA and hospital HVA 18
 community rituals 455
 community-wide responses and leadership 7
 enhancing the lives of nurses and communities after disaster 490–1
 and hospital operational preparedness 101–17
 immediate needs of the community 5, 9–10
 knowledge of the medical community 326
 research related to patients 564
 and response planning 336–7
 restoration of community functioning 506–7
 Community Emergency Response Teams 36
 Community Health Nurse (CHN) 394
 compensated internal disasters 143
 compensation/claims unit (of HICS) 173
 competencies 491, 549–56
 complex emergencies 428–9
 compound incidents 142–3
 computer simulations 23, 380
 Computerized Tomography (CT) 261
 concept analysis (research approach) 578
 connectedness (characteristic) 463
 consciousness 67
 conservation buffer zones 501
 contamination
 biological contamination 150, 203–5
 and blast injury 258–9
 chemical exposure 185, 272–3
 contamination analysis 281
 exposure versus contamination — radiation 223–4
 hospital contamination 282–3
 Immediately Dangerous to Life and Health (IDLH) level 277
 indirect (secondary) contamination 266, 267–8
 and influenza pandemics 416–17
 internal contamination 224, 226, 245–8
 primary contamination 266
 reduction of 50
 of water 130–1, 437, 439, 517–18
 see also decontamination
 contingency plans/planning 131–2, 381–3, 451
 control measures 391–3
 convergence behavior 35–6, 37
 cost unit (of HICS) 173
 cough etiquette 413–14
 Council of State and Territorial Epidemiologists (CSTE) 390
 epidemiological investigations 392–3
 creativity 7, 10
 CRED *see* Centre for Research on the Epidemiology of Disaster
 credentialing 127, 328–30, 522
 Crisis Response Team (CRT) 539–40
 critical care 106–8, 219–20
 Critical Incident Stress Management (CISM) 96–7
 critical thinking 6, 7
 criticality incidents (radiation) 226–7
 cross-contamination 236
 cross-training (strategy) 125–6
 crowds/crowd control 104–6
 CRT *see* Crisis Response Team
 crude mortality rate (CMR) 431–2, 446
 crush injury/syndrome 259–60
 CSTE *see* Council of State and Territorial Epidemiologists
 CT *see* Computerized Tomography
 CTG *see* childhood traumatic grief
 cultural competence 491
 cultural issues 311, 360
 cutaneous syndrome 241, 242
 Cyclone Tracy 150, 507
 cytogenetic biodosimetry 244
 Cytogenetic Biodosimetry Laboratory (CBL) 244
 cytokines 243
 cytomegalovirus (CMV) 244
- D**
 damage 586, 591–2
 DART *see* Disaster Assistance Response Team
 debriefing 25, 76, 97, 450–1, 459–60
 deceased (black) triage category 58, 59–60
 deceleration 255
 decontamination 22, 81, 83, 86, 94, 103, 265–86
 and chemical preparedness and response 183–97
 decontamination team 269, 279–80
 decontamination zones 273–6
 definition 266–7
 and drill evaluation 24
 dry contamination 267
 Hazardous Materials (HazMat) Team 49–50
 hospital decontamination teams 268–9

INDEX

- irrigation 235–6, 248
- issues 280–5
 - process 272–80
 - and radiation 234, 235–7
 - reasons for decontamination 267–8
 - role of the physician 269
 - sites 381
 - training 22, 270–1
 - and victims of chemical incidents 195–6
 - wet contamination 267
- see also* contamination; personal protective equipment
- Decontamination Logistics Manager 279
- Decontamination Security Manager 280
- Decontamination Triage Manager 279
- decorporation 245, 248
- defibrillation (skill) 43
- definitive medical care 354
- dehydration 312, 427, 434, 441, 533
- demobilization unit (of HICS) 173
- demographics 292, 299
- deontological ethical decision-making approach 475–7
- Department for International Development (UK) 358
- Department of Health and Aging 388
- Department of Health and Human Services (HHS) 341–2, 358, 388–9, 535
- Department of Homeland Security (DHS) 388
- depression 455–6, 466, 533
- descriptive studies (research approach) 575–6
- detection (of chemical exposure) 194–5, 281
- development (disaster management phase) 16, 495, 588–90, 593
- diagnostics 112
- diarrhea 427, 432, 433, 434–5, 518, 521–2, 539
- Diazepam 187, 188
- dimercaprol (British anti-lewisite) 190
- direct (primary) contamination 266
- dirty bombs 226
- disability 292–3, 297, 305
- disabling chemicals 192–3
- Disaster Assistance Response Team (DART) 358, 359
- Disaster committees 140
- disaster communication strategies 107–11
- disaster ethics 473–91
 - approaches to ethical thinking 474–7
 - bioethics development 474
 - challenges to ethical practice during disasters 479–84
 - ethical decision-making 482, 485–7
 - ethical preparation for disasters 477–9
 - human rights and disaster ethics 487–90
- disaster health research template 590–3
- Disaster Information Centers 134
- Disaster Medical Assistance Teams (DMAT) 328–9, 343–4, 349, 358, 536, 537
- disaster mental health 449–70
 - core response principles 450–1
 - mental health 453–63, 465–70
 - normal responses to stress 452–3
 - post-trauma symptoms 456–60
 - potential individual survivor responses 452–3
 - pre-existing severe mental disorders 465
 - preparedness 451–2
 - preventing mental health problems following disaster 453–5
 - psychological first aid 463–5
- Disaster Mortuary Operational Response Team (DMORT) 212, 345
- disaster nursing
 - and adaptability 6–7
 - adverse conditions 5
 - caring for the community during disaster 3–4, 25
 - characteristics 3–10
 - critical thinking 6, 7
 - disaster management phases 8–10
 - disaster nursing responses in Japan 365–73
 - educational competencies 549–56
 - EMS responses in a disaster 44–7
 - goal 3
 - leadership 7–8
 - personal impact 4–5
 - research 561–79
- Disaster Nursing Response Network 562, 565
- disaster recovery 495–508
 - healthcare systems recovery 503–7
 - issues in recovery 498–503
 - nursing roles in recovery 507
 - principles of recovery management 497–8
- disaster triage 57–77, 193–4, 479
 - considerations 93
 - in-hospital triage 71–6
 - location 91
 - process 60–4, 93
 - record-keeping issue 93
 - supplies/equipment 91–2
 - triage area personnel 92
 - triage systems 64–71
 - triage taxonomies 60
- disaster-related nursing research 563–5
- disasters
 - ‘all-hazards’ disaster planning approach 15, 20, 26, 131, 326–7
 - and children 307–19
 - community behavior and response to disaster 29–37
 - definitions 2
 - ED notification of disaster 82–3
 - ethical preparation for 477–9
 - failure of communications systems 48–9
 - ‘golden’ first hour 34
 - health disasters 2
 - health records during 546
 - hospital disaster plan activation 84, 95
 - humanitarian emergencies 427–46
 - internal disasters 139–61
 - international disasters response 351–62
 - medical disaster 44
 - and mental health problems 453–62
 - myths 563
 - natural event disasters 365–73
 - phases 16, 495, 588–90
 - preparing for disasters 98, 311–12
 - prioritizing resource allocation 479–80
 - record-keeping and documentation 93
 - role of clergy 90
- discourse analysis (research approach) 578
- dispersal incidents (radiation) 226
- displaced persons 314, 428, 440, 468, 515, 522, 536, 546
 - and shelter 443–4
 - and vector control 444–5
- disturbances (in function/health status) 592
- Diversity Outreach Initiative 298
- Division of Emergency and Disaster Management 378
- DMAT *see* Disaster Medical Assistance Teams; Pediatric Disaster Medical Assistance Team
- DMORT *see* Disaster Mortuary Operational Response Team

do no harm (core response principle) 450–1
 doctrines (national) 379
 documentation unit (of HICS) 173, 174
 donations 502
 dose-rate meters 232–3
 dosimetry 243–4, 247
 double-gloving 231
 drag sheets 156
 drills 9–10, 23–5, 97, 311, 312, 379, 380, 486–7
 drug problems 461
 DTPA *see* care 481–3
 dysentery 427, 438, 446

E

Early Aberration Reporting System (EARS) 391
 Early Estimation System (EES) 367
 earthquake 316, 319, 355, 365, 368, 373, 564, 575
 and descriptive studies 575–6
 impact 514–16
 research 564
 Southeast Asia tsunami 513–26
 Ebola 200, 216
 EBP *see* evidence-based practice
 ECDC *see* European Center for Disease Prevention and Control
 economic impact (recovery issue) 498–9
 ED *see* Emergency Department
 edema 441, 442–3
 education 22–5, 76, 98, 368, 370, 371–2, 536
 challenges 23
 disaster education 555–6
 disaster nursing educational competencies 549–56
 educational films 380
 First Responder Awareness Level education 270–1
 research—responding personnel 563–4
 EES *see* Early Estimation System
 EISS *see* European Influenza Surveillance System
 elderly (vulnerable group) 294–6, 303, 466–7, 542, 564
 electrical power 108–9, 129–30, 144–5, 532
 EM *see* Emergency Management
 EMA *see* Emergency Management Australia
 EMAC *see* Emergency Management Assistance Compact; National Emergency Management Assistance Compact
 emergency actions 152–6
 Emergency Care Practitioner (EMS title) 42
 emergency codes 84
 Emergency Department (ED) 81–99, 230–1, 357, 382
 activation of the hospital disaster plan 84
 augmentation of normal practices 107
 critical incident stress management 96–7
 decontamination team 269, 279–80
 disaster triage 91–3
 evaluation 97–8
 and impact of disaster 111–12
 incident command in the ED 85
 interruptions in power, water, oxygen and suction 88
 key roles 85
 notification 82–3
 patient care 95–6
 patient flow within the ED 94–5, 112, 283
 pharmaceuticals 87–8
 preparing for disasters 98, 127–8, 327–8, 541
 priorities 85–6
 recovery and return to normal operations 98
 scalable decontamination approach 272
 staffing requirements 89–91, 283
 standardized treatment plans 96
 supplies and equipment 86–8, 91–2
 victim arrival 83
 Emergency Management Assistance Compact (EMAC) 330, 338, 534
 Emergency Management Australia (EMA) 53, 565–6
 Emergency Management (EM) 52–4
 emergency management plans (EMPs) 290, 291, 397
 Emergency Management Program (EMP) 165, 325
 Emergency Medical Responders (EMRs) 42
 Emergency Medical Services (EMS) 2, 41, 42–9, 291, 323, 375, 381–2
 communications 48–9
 core role 42
 ED notification of disaster 82–3
 EMS responses in a disaster 44–7
 EMS triage 45–6
 goals of EMS activity 44–5
 organizational sectors and functions 46, 47
 scene difficulties 47–8
 types of emergencies and disasters 44
 Emergency Medical Technicians (EMTs) 42
 Emergency Nurses Association (ENA) 324
 Emergency Operations Center (EOC) 53, 329, 533
 Emergency Operations Plan (EOP) 20–1, 23–5, 166, 270
 Emergency Reception Team (ERT) 228, 229, 238
 Emergency Severity Index 74–5
 Emergency Support Functions (ESFs) 340, 341, 342, 388
 Emergency System for Advanced Registration of Volunteer Health Professionals (ESAR-VHP) 127, 330, 348
 emergency/emergent (red) triage category 58, 59, 62
 emergent organizations 34–5
 emotional responses 96–7
 emotional responses (to stress) 69, 452–3
 EMP *see* Emergency Management Program
 empowerment (characteristic) 463
 EMPs *see* emergency management plans
 EMRs *see* Emergency Medical Responders
 EMS *see* Emergency Medical Services
 EMT *see* Epidemiological Management Team
 EMTs *see* Emergency Medical Technicians
 ENA *see* Emergency Nurses Association
 endoscopy 247
 environment (response challenge) 360
 Environmental Protection Agency (EPA) 276–9, 284, 417
 EOC *see* Emergency Operations Center
 EOP *see* Emergency Operations Plan
 epidemic 400, 433
 epidemiologic studies (research approach) 576
 Epidemiological Management Team (EMT) 378
 epidemiology 392–3, 565
 equipment
 battery-powered equipment 130
 ED supplies and equipment 86–8, 91–2
 for measuring children's height and weight 312
 medical equipment needs 22, 296–7
 procurement of 381
 for response to a biological event 206–7
 shortages 6
 and surge capacity 127–8
 equity 497–502
 ER ONE 21
 ERT *see* Emergency Reception Team
 ESAR-VHP *see* Emergency System for Advanced Registration of Volunteer Health Professionals

INDEX

escape routes 151, 154
 ESFs *see* Emergency Support Functions
 essential systems 144–7, 150–1
 established organizations 33–4
 ethics 473–91
 ethical decision-making 482, 485–7
 ethical issues 419
 see also bioethics
 European Center for Disease Prevention and Control (ECDC) 388–9
 European Influenza Surveillance System (EISS) 391
 evacuation 82, 148–60, 161, 291, 323, 343, 346, 508
 assembly points 156
 carrying methods 155–6
 causes for evacuation 149–51
 community evacuation behavior 30–7
 disaster preparedness for pets 293–4
 due to bomb threats 147–8
 emergency actions 152–6
 evacuation shadow phenomenon 33
 fire (evacuation cause) 149, 291
 horizontal evacuation 152
 and Hurricane Katrina 530, 537–8
 and international disasters response 354
 nature-related events (evacuation cause) 149–50
 preventative precautionary evacuation 148–9
 private possessions 154
 process 151
 resumption of hospital activity 162
 self-evacuation 37
 as a social activity 32–3
 time required 155
 transferring patients 157–8
 transportation 159–60
 types 151–2
 waterborne evacuation 29–30, 31–2, 36
 evaluations (research approach) 572
 events 170, 203–5, 391, 394, 584–6, 588–90, 591
 evidence-based medicine (EBM) movement 569, 570
 evidence-based practice (EBP) 561–2, 565–72
 exchange carts 92
 exclusion zone/hot zone 46, 62, 274–5
 exercises 23–5, 140, 486–7
 expanding organizations 34
 experimental/quasi-experimental studies (research approach) 575
 explosions 254–5
 explosive event preparedness 253–62
 exposure incident (radiation) 225–6
 extending organizations 34
 external contamination 224
 external vulnerabilities 17

F

facilities (hospital) 122–3
 see also health facilities
 fair treatment 497–502
 families (and hospital care) 104–5
 famine edema 442–3
 FAST *see* focused abdominal sonography for trauma
 FDA *see* Food and Drug Administration
 fear 32, 485
 Federal Coordinating Centers (FCCs) 345–6
 Federal Emergency Management Agency (FEMA) 53, 298, 340, 508, 534–5, 566
 Federal Medical Stations (FMS) 347–8
 Federal Response Plan 339

fever clinics 208–9, 410
 FFH *see* Foreign Field Hospitals
 field EMS triage 45, 46, 193, 521
 finance and administration section (of HICS) 173
 finance/administration section chief (ICS) 168
 fire (evacuation cause) 149, 291
 fire personnel (typical First Responders) 42–4, 49, 330
 first receivers 270
 First Responders 41–54, 270–1, 325, 330, 338, 383
 flow (of patients) 94–5, 112, 283
 fluid management 260
 FMS *see* Federal Medical Stations
 focused abdominal sonography for trauma (FAST) 261
 food 131
 Food and Drug Administration (FDA) 411–12
 food supply 439–43, 532, 533
 Foreign Field Hospitals (FFH) 506
 forensic identification 523–4
 ‘four S’s’ (preparedness process components) 121–2
 framework (disaster research) 583–97
 fuel 129–30

G

G agents 186
 gamma rays 223
 ‘gas mania’ 204
 gastrointestinal syndrome 241, 242
 Geiger-Muller (GM) counter 232
 Global Patient Movement Requirements Center (GPMRC) 346
 global public health agencies 388–9
 GoI-UNDP Disaster Management Programme 25–6
 Good Humanitarian Donorship 502
 governments
 collapse of 523
 and Emergency Management 52–4
 and international disasters response 357–8
 Japanese government’s emergency response 366–7
 and relief 520–1
 and response planning 337–8
 Governor’s Health Care Reform Panel 534
 GPMRC *see* Global Patient Movement Requirements Center
 Gray unit (radiation unit) 224, 244
 ‘green’ dependency (electrical power) 145
 grief 460, 519
 Ground Self-Defense Force (Japan) 367, 368
 group activity principle 31
 groups (ICS) 168
 Guidance on Preparing Workplaces for an Influenza Pandemic [publication] 407
 Gulf War 375, 379–80

H

HAN *see* Health Alert Network
 hand washing 413, 595–6
 hazard vulnerability assessment 326–7
 Hazardous Materials (HazMat) 49–50, 86, 150, 172, 193, 278, 279, 382
 Hazardous Substances Emergency Events Surveillance (HSEES) 266, 268
 Hazardous Waste Operations and Emergency Response Standard 270
 hazards 17, 584, 585
 Hazards and Vulnerability Analysis (HVA) 8, 18–19, 20, 291
 HCC *see* Hospital Command Center

- HCN *see* hydrogen cyanide
 Headquarters for Major Disaster Management 366
 Headquarters for Urgent Disaster Management 366
 Health Alert Network (HAN) 206, 210
 Health Disaster Management Guidelines for Evaluation and Research in the Utstein Style [publication] 567, 597
 health disasters 2
 Health Maintenance Organizations (HMOs) 375, 383
 health physicists (HPs) 237
 health records 546
 Health Resources and Services Administration (HRSA) 121, 330
 healthcare facilities
 and the beneficence principle 132–3, 476, 483
 cleaning of contaminated environments 416–17
 healthcare facility response 209–13
 healthcare involvement in regional planning 324–5
 incident command 165–81
 infrastructure 129, 143–4
 overloaded healthcare systems 404
 preparedness of 13–27, 205–9
 resilience of 120
 risks analysis 140
 sustainability during bioterrorism 211–13
 healthcare management 237–40, 243–4, 328–9
 Healthcare Preparedness Council 325
 healthcare systems recovery 503–7
 health-vulnerability assessment (HVA) 327, 334
 HEAR *see* Hospital Emergency Administrative Radio system
 hemagglutinin (H) 397
 hematopoietic syndrome 241, 242, 244, 247
 hemorrhage control 59
 hepatitis B 259
 herpes simplex virus (HSV) 244
 HHS *see* Department of Health and Human Services
 HICS *see* Hospital Incident Command System
 High Efficiency Particulate Air (HEPA) filtration 207, 208, 244, 417, 436
 high-order explosives 254
 HIV *see* human immunodeficiency virus (HIV)
 HIV/AIDS 437, 438
 HMOs *see* Health Maintenance Organizations
 home care 123
 Home Front Command 375, 378, 381
 Homeland Security Presidential Directive #5 338–9, 387–8
 hope (characteristic) 464
 Hospital Command Center (HCC) 174–9
 Hospital Emergency Administrative Radio system (HEAR) 82
 Hospital Incident Command System (HICS) 21, 22, 23, 85, 170–4, 210
 CBRNE events 170
 and drill evaluation 24
 HICS components 173–4
 HICS positions 170–3
 incident command 165–81
 operations section 172
 Hospital Preparedness Program (HPP) 26
 Hospital Safety Index (HSI) 19–20
 hospitals
 Charity Hospital 531, 538
 Emergency Department 81–99, 230–1, 357, 382
 and EMS communications 48–9
 facilities 122–3
 hospital contamination 282–3
 hospital decontamination teams 268–9
 hospital disaster plans 84, 95
 hospital impact
 communications 106–11
 contingency planning 131–2
 department impact 111–14
 the Emergency Department 81–99, 230–1, 357, 382
 internal disasters 139–61
 lifelines 128–31
 public relations 134–5
 resilience 120
 resource management 114–16
 scarce resources 132–4
 security issues 102–6
 hospital preparedness planning 20–6
 in-house Burn Surge Plans 114
 lockdown 102–3, 210
 pediatric hospital supplies 317
 safe and resilient hospitals 25
 shuttered hospitals 122
 surging hospitals and requisitioning 128
 systems 143–7
 Texas Children's Hospital 540, 542
 transfer of patients 114, 123, 157–8
 vulnerabilities 16–20, 530
 see also healthcare facilities
 hot zone/exclusion zone 46, 62, 274–5
 'hotwash' sessions 25
 housing (children) 316–17
 HPP *see* Hospital Preparedness Program
 HPs *see* health physicists
 HRSA *see* Health Resources and Services Administration
 HSEES *see* Hazardous Substances Emergency Events Surveillance
 HSI *see* Hospital Safety Index
 HSV *see* herpes simplex virus
 human capital 35
 Human Immunodeficiency Virus (HIV) 243, 244, 437
 human influenza 389, 595–7
 human rights 445, 450, 487–90
 Humane Society of the United States 293–4
 humanitarian emergencies 427–46
 Humanitarian Medical Assistance in Japan (HuMA) 370–1
 Hurricane Katrina 34–5, 44, 135, 150, 151, 160, 289–90, 323
 and alternative care sites 123
 baseline status of healthcare infrastructure and services 530–1
 and children in disasters 308, 311, 315
 and disaster planning 325
 and elderly people 294
 emergency medicine and public health considerations 533
 and ethical decision-making 485
 evacuations 537–8
 events chronology 530
 federal responses 534–7
 health aspects 529–46
 and hospitals 105
 impact on medical infrastructure 532–3
 and impoverished citizens 488
 and legal liability 127
 lessons learned 543–5
 preparedness activation 531
 provision and coordination of healthcare services 508

INDEX

- recovery 542–3
- and sheltering 538–9
- special populations 539–42
- state responses 533–4
- hurricanes 149–50, 329–30, 563
 - Hurricane Andrew 290, 323
 - Hurricane Charley 129, 349
 - Hurricane Isabel 91
 - Hurricane Rita 33, 123, 135, 289–90, 323
 - see also* Hurricane Katrina
- HVA *see* Hazard and Vulnerability Analysis; health-vulnerability assessment
- hydrogen cyanide (HCN) 191–2
- hypothermia 308
- I**
- IAEA *see* International Atomic Energy Agency
- IAP *see* Incident Action Plan
- IASC *see* Inter-Agency Standing Committee
- ICD-10 *see* International Statistical Classification of Diseases and Related Health Problems Version 10
- ICN *see* International Council of Nurses
- ICNP *see* International Classification for Nursing Practice
- ICRC *see* International Committee of the Red Cross
- ICS *see* Incident Command System
- ICUs *see* intensive care units
- identification 81, 104–5, 147, 284, 315, 345, 382, 518
 - forensic identification 523–4
 - and mental health problems 455
 - of special needs 290–1
 - Veteran Affairs (VA) system 296, 537, 539–40
 - within the HCC 178
- IDPs *see* internally displaced persons
- IFRC *see* International Federation of Red Cross and Red Crescent Societies
- IGOs *see* intergovernmental agencies
- IHR *see* International Health Regulations
- Illinois Medical Response Team (IMERT) 541
- Immediately Dangerous to Life and Health (IDLH) level (contamination) 277
- immunization 259, 534, 536
- impact (risk component) 18
- Implementation Plan (pandemics) 406–7
- implosion 255, 256
- IMSuRTs *see* International Medical Surgical Response Teams
- Incident Action Plan (IAP) 167, 168, 170
- Incident Command System (ICS) 83, 85, 134–5, 141–2, 165–81, 228, 354–6, 362
 - and coordinated incident management 339
 - directors 169
 - ICS as component of regional planning 327
 - ICS components 168–9
 - ICS positions 167–8
 - public health incident command 180–1
 - section chiefs 168
 - unified command 169–70
 - see also* Hospital Incident Command System
- incident commander (of ICS) 167, 175–8, 271, 279, 354–5
- incident management team (of HICS) 170, 171
- incidents 142–3
- indirect (secondary) contamination 266, 267–8
- infection control 389–92, 399, 413
- infectious diseases 432, 433–7, 438, 517–18, 536
- influenza 389, 398–9, 400, 595–7
 - avian influenza 399, 401, 414, 420–1, 563
- influenza pandemics 397–422
- informal responses (to disaster) 33–7
- information communication technology 107–8
- infrastructure 129, 143–4, 428, 505–6, 513–26, 532–3
- infrastructure branch (of HICS) 172, 381
- initial needs assessment 430–2
- initiatives
 - Diversity Outreach Initiative 298
 - Governor's Health Care Reform Panel 534
 - hospital preparedness initiatives 25–6
 - initiatives for integration of informal, unsolicited first responders 36–7
 - mitigation initiatives 8
 - National Nursing Emergency Preparedness Initiative 553
 - 'Safe and Resilient Hospital' initiative 25
 - strategic initiatives — special needs populations 297–302
- insecticides 434
- integration (core response principle) 451
- Intensive Care Units (ICUs) 113, 145
- interactive computer programs 380
- Interagency Coordinating Council in Emergency Preparedness and Individuals with Disabilities 302
- Inter-Agency Standing Committee (IASC) 356
- intergovernmental agencies (IGOs) 324
- Interim Pre-pandemic Planning Guidance [publication] 407–9
- internal contamination 224, 226, 245–8
- internal disasters 139–61
 - bomb threats 147–8
 - compensated internal disasters 143
 - essential systems 144–7, 150–1
 - evacuation 82, 148–60, 161, 291, 323, 343, 346, 508
 - incident command 85, 141–2
 - incidents 142–3
 - Planning and Safety Committee 140
 - system disruptions 143–4
 - uncompensated internal disasters 143
- internal vulnerabilities 17
- internally displaced persons (IDPs) 428
- International Atomic Energy Agency (IAEA) 252
- International Classification for Nursing Practice (ICNP) 567
- International Commission on Radiological Protection 252
- International Committee of the Red Cross (ICRC) 357, 497
- International Council of Nurses (ICN) 3, 553, 562, 565, 567
- international disasters response 351–62
- International Federation of Red Cross and Red Crescent Societies (IFRC) 357
- International Health Regulations (IHR) 389–90
- International Medical Surgical Response Teams (IMSuRTs) 344, 352, 358
- International Nursing Coalition for Mass Casualty Education (NEPEC) 550, 553–5
- International Statistical Classification of Diseases and Related Health Problems Version 10 (ICD-10) 449–50
- International Strategy for Disaster Reduction (ISDR) 25
- interoperability 110–11
- interventions 466, 564, 575, 592, 595–7
 - alcohol and drug problems 461
 - effects 592–3, 595

and needs assessments 592
 psychological first aid 463–5
 shelter-related interventions 499
 ‘Intifada’ 377
 intravenous access (skill) 43, 432
 ionizing radiation 222
 irradiation 223
 irrigation 235–6, 247
 ISDR *see* within the HCC 178
 typhoon 365
 isolation/isolation areas 208, 393–4, 406, 408, 488–9
 Israeli Defense Forces (IDF) Medical Corps 375, 378
 Israeli health system 375–84

J

Japan Disaster Relief (JDR) team 369
 Japan Disaster Relief Team Dispatch Law 367
 Japan International Cooperation Agency (JICA) 369
 Japan Medical Team of Disaster Response (JMTDR) 369–70, 372
 Japan Self-Defense Forces (JSDF) 367–8, 372
 Joanna Briggs Institute 571
 Job Action Sheets 89, 174, 175–8
 Joint Commission International (JCI) 25
 Joint Commission on Accreditation of Healthcare Organizations (JCAHO) 129, 165–6
 JumpSTART triage system 67, 69–70, 312
 justice principle 475, 476, 483
 just-in-time re-supply system 127, 205, 404, 504
 just-in-time training 553

K

KI *see* potassium iodide

L

laboratory dosimetry 243–4
 landing/Medevac zone 46
 language barriers 292, 355
 latent phase (of ARS) 241–2
 leadership 7–8
 Levels A, B, C, D protection (PPE) 276, 277–9
 lewisite 189–90
 liability 127, 168, 331
 liaison officers 167–8
 life- and limb-threatening injuries 233
 life support allocation 475–6
 lifelines 128–31
 LINKS 534
 ‘load and go’ situation 576
 Local Emergency Operations Center (LEOC) 168
 Local Emergency Planning Committees (LEPC) 325
 lockdown 102–3, 210
 logistics section chief (ICS) 168
 logistics section (of HICS) 172
 log-rolling (of patients) 233, 237
 London Bombings 77, 109, 113, 123, 262
 longitudinal disaster framework 588–90
 Lonz Winery disaster 329
 Louisiana State University Health Sciences Center (LSUHSC) 534, 541
 low-order explosives 254
 lung irritants 190–1
 Lysergide (LSD) 192

M

MAC *see* Multiagency Coordination System
 Madrid Bombings 83, 90, 308

Major Incident Committees 140
 malaria 432, 433–4, 438
 malnutrition 427, 433, 440, 442–3
 Management Support Teams (MSTs) 345
 Manchester Triage System 73–4
 manifest illness phase (of ARS) 241–2
 manual ventilation 145
 Maritime Self-Defense Force (Japan) 367, 368
 MARK 1 kit (nerve agent drug therapy) 187
 masks (protective) 207, 209–10, 231, 387, 413, 414, 417, 436
 mass burials (victims) 116
 mass-casualty events (MCEs) 550, 552, 553
 Mass-Casualty Incident (MCI) 44, 45, 84, 113, 375, 376, 377, 380
 common site problems for EMS 47–8
 contingency plans 381–2
 pre-casualty contact 61
 response 351
 see also After Action Reviews
 mass healthcare 328–9
 mass psychogenic illness (MPI) 195
 mass toxicological incident (MTI) 382–3
 maximizing utility principle 133
 MCI *see* Mass-Casualty Incident; Multiple Casualty Incident
 measles 432, 433, 438
 Medallion System 210
 Medevac/landing zone 46
 media 105–6, 360–1, 453, 486
 Medicaid 530–1, 534, 542
 medical care branch (of HICS) 172
 Medical Center of Louisiana at New Orleans (MCLNO) 531
 medical disaster 44
 Medical Disaster Response System 67, 69
 medical equipment 22
 see also stuff (disaster response measure); equipment; supplies
 medical gas supply 145–6
 medical monitoring 279, 281
 Medical Monitoring Manager (decontamination) 279
 Medical Reserve Corps (MRC) program 36, 126, 339
 medical simulation centers 380
 medical teams 343–6
 medical technical specialist (of HICS) 170
 medication administration (skill) 43
 medications 22, 295, 317–18, 432, 459, 523
 Memoranda of Agreements (MOA) 330
 Memoranda of Understanding (MOU) 116, 294, 297, 409, 594
 meningococcal meningitis 438
 mental health 449–70, 522
 meta-analysis (research approach) 574–5
 mid-upper arm circumference (cm) measurements (MUAC) 440–3
 military 244, 348, 359, 367, 368
 Minimal Initial Services Package (MISP) 437
 Ministry of Health (MOH) 375, 381
 miosis 186, 188
 mitigation (disaster management phase) 8, 16, 19, 21, 36, 49, 53
 mock drills 23
 Model State Emergency Health Powers Act 386
 monitoring (telephone) 410
 morals/morality 474, 475, 485
 morbidity 44–5, 54, 65, 69, 72, 309, 389, 390–1

INDEX

and damage 591–2
and HIV/AIDS 437
and surveillance 391
unpredictable casualty estimates 405
Morbidity and Mortality Weekly Report (MMWR) 390
morgue (sector) 46, 116–17
mortality 44–5, 65, 72, 309, 345, 376, 389, 390–1
 crude mortality rate 431–2, 446
 and damage 591–2
 and HIV/AIDS 437
 maternal mortality and Vitamin A deficiency 433
 and Southeast Asia tsunami 515
 and surveillance 391
 unpredictable casualty estimates 405
MOU *see* memoranda of understanding
MPI *see* mass psychogenic illness
MSTs *see* Management Support Teams
MTI *see* mass toxicological incident
MUAC *see* mid-upper arm circumference (cm)
 measurements
Multiagency Coordination System (MAC) 179
multi-layered support (core response principle) 450
Multilingual Dictionary of Disaster Medicine
 [publication] 567
Multiple Casualty Incident (MCI) 4, 24, 44, 45, 61, 84, 113
mustard gas 188–9
Mutual-Aid Agreements 330, 331, 337

N
N-95 mask 387, 414, 415, 417
National Center for Missing and Exploited Children (NCMEC) 135, 315, 316
National Council on Disability/National Organization on Disability 293, 297
National Council on Radiation Protection & Measurements (NCRP) 252
National Disaster Life Support (NDLS) program 555
National Disaster Medical System (NDMS) 126, 294, 342–3, 358, 535, 536, 539
National Emergency Child Locator Center 316
National Emergency Council (NEC) 378
National Emergency Management Assistance Compact (EMAC) 126
National Incident Management System (NIMS) 23, 165, 166, 170, 179–80, 339
National Notifiable Disease Surveillance System (NNDSS) 390–1
National Nurse Response Teams (NNRTs) 344
National Nursing Emergency Preparedness Initiative (NNEPI) 553
National Organization of Nurse Practitioner Faculty (NOPF) 553
National Panel for Advanced Practice Registered Nurses (APRN) Emergency Preparedness and All-Hazards Response Education 553
National Pharmacy Response Teams (NPRTs) 344
national public health agencies 388–9
National Response Framework (NRF) 294, 324, 338–42
National Response Plan (NRP) 339, 340
National Strategy for Pandemic Influenza 406–7
natural hazards 584, 585
NCMEC *see* National Center for Missing and Exploited Children
NCRP *see* National Council on Radiation Protection & Measurements
NDMS *see* National Disaster Medical System

NEC *see* National Emergency Council
needs 5, 9–10, 465–6, 592
NEPEC *see* Nursing Emergency Preparedness Education Coalition; International Nursing Coalition for Mass Casualty Education
nerve agents 186–7
neuraminidase (N) 398
neurological status 66
neurovascular syndrome *see* cerebrovascular/central nervous system syndrome
neutrons 223
New Mexico Disaster Medical Assistance Team 541
NIMS *see* National Incident Management System
NNDSS *see* National Notifiable Disease Surveillance System
NNEPI *see* National Nursing Emergency Preparedness Initiative
NNRTs *see* National Nurse Response Teams
non-governmental agencies (NGOs) 324, 336–7, 358, 367, 429, 520–1, 522
non-maleficence principle 476, 483
non-mechanical cooling (of bodies) 116
non-medical team (decontamination) 268–9
non-pharmaceutical intervention 413, 420
non-structural vulnerability 18
non-urgent (green) triage category 58, 59, 65, 103, 281
NOPF *see* National Organization of Nurse Practitioner Faculty
NPRTs *see* National Pharmacy Response Teams
NRF *see* National Response Framework
NRP *see* National Response Plan
nuclear incidents 225–7
nurses
 Community Health Nurse 394
 and disaster preparedness 27
 duty to care 481–3
 enhancing the lives of nurses and communities
 after disaster 490–1
 ‘graying’ of the nursing pool 551
 lack of recognition of 5
 mental health needs of disaster healthcare workers 467–70
 National Nurse Response Teams 344
 personal impact of disaster 4–5
 problem solving counseling 464
 roles 368, 369–70, 371, 507
 roles within disaster response 324
 scope of care 4
 shortage 404
 see also American Nurses Association
nursing
 definitions 3
 in the phases of disasters 8–10
 practice standards 330–1
 school of nursing programs 556
 see also disaster nursing
Nursing Emergency Preparedness Education Coalition (NEPEC) 551–2, 556
nutrition 439–43

O
Occupational Health and Safety Committee 140
Occupational Safety and Health Administration (OSHA) 207, 270–1, 272, 417
‘off-gassing’ 185–6, 191, 266, 285
Office for the Coordination of Humanitarian Affairs (OCHA) 356

- Office of Emergency Management 51, 53–4, 332
Office of Emergency Preparedness 294
Oklahoma City Bombing 106–7, 308, 309, 329–30
Older Adult Disaster Evaluation Assessment Tool 564
on-site casualty sorting (triage process) 61–4
Ontario System (of triage) 219–20
operating rooms/theatres (OR) 94, 112, 113, 153
Operation Sumatra Assist 359
operational (mock) drills 23
operations section chief (ICS/HICS) 168, 172
Oral Rehydration Therapy (ORT) 434–5
‘orange’ dependency (electrical power) 145
organizational behaviors (in a disaster) 33–5
organizational vulnerability 18
oseltamivir (antiviral agent) 411–12
OSHA *see* Occupational Safety and Health Administration
outpatient services 297
over-triaging 62, 63–4
oxygen 143, 145–6, 149, 154, 261
- P**
PAHO *see* WHO/Pan American Health Organization
pandemic influenza A (H1N1) virus 398, 400, 401, 404–5, 406, 411, 412, 420–1
pandemic planning 397–422
Pandemic Severity Index 407–9
panic 31–2, 33
paramedics 42
Parkland Fluid Replacement Formula 260
participation (core response principle) 450
participatory action research (PAR) 577
partnerships 126
Pasadena (antidote) kit 192
Patient Prioritization Matrix 134
patients
 ambulatory versus non-ambulatory patients 154–5
 grouping according to triage category 94
 immunologically compromised patients and radiation 244
 patient care in the ED 95–6
 patient flow 94–5, 112, 283
 patient numbers as preparedness standard 121
 patient stratification 133
 patient tracking 81, 157–8, 284
 patients and crowds 104
 research related to patients 564
 transfer of patients 114, 123, 157–8
 ‘worried well’ patients 204, 273, 280
PB *see* Prussian blue
PD *see* practice development
Pediatric Disaster Medical Assistance Team (DMAT) 318
Pediatric Triage Tape 67, 68, 69, 312
pediatrics 283–4, 297, 307–19
 see also children, disasters and
PEEP *see* positive end-expiratory pressure
PEM *see* protein-energy malnutrition
pentatate (DTPA) 245–6
people with disabilities 292–3
personal protective equipment (PPE) 186, 196, 205, 207, 209, 212, 216–18, 231
 and decontamination 265, 270, 276–9, 382
 need for 268
 and transmission control measures 413
Pete Maravich Assembly Center (PMAC) 541
pets 299–300
pharmaceuticals 87–8, 127–8, 327–8, 541
 see also Strategic National Stockpile
phosgene 190–1
photons 223
physical capital 35
physical responses (to stress) 452–3
PIS *see* Public Information System
plague 201, 203, 211, 216, 389
planning 15, 20, 26, 131–2, 323–32, 334, 381–3, 451
 redundancy planning 109–10, 130
Planning and Safety Committee (healthcare facility) 140
planning section chief (ICS) 168, 311–12
planning section (of HICS) 173
‘play and stay’ situation 576
PMAC *see* Pete Maravich Assembly Center
poisons 186–7
policy development (public health role) 386–7
poliomyelitis 389
pollution 284–5
population monitoring 248–9
populations (special needs/vulnerabilities) 289–303, 305–6
positive end-expiratory pressure (PEEP) 189
post-trauma symptoms 456–60
post-traumatic stress disorder (PTSD) 96–7, 257, 310, 311, 450, 457–60, 466, 469
potassium iodide (KI) 246, 318
power issues 108–9, 144–5
practice development (PD) 568–71
practice standards 483–4
Pralidoxime (‘2-PAM’) 187
pre-event phase (disasters) 588–90, 591
preparedness (disaster management phase) 8–9, 16, 19, 327
 biological preparedness and response 199–213, 216–20
 challenges to 14
 chemical preparedness and response 183–97
 and contingency planning 131–2
 and disaster mental health 451–2
 disaster preparedness for pets 293–4
 explosive event preparedness/response 253–62
 healthcare facility preparedness 13–27, 205–9
 Healthcare Preparedness Council 325
 hospital operational preparedness 101–17
 hospital preparedness planning 20–2, 23, 25–6
 and Hurricane Katrina 531
 of Israeli health system 375–84
 Nursing Emergency Preparedness Education Coalition 551–2, 556
 and pandemics 405–20
 patient numbers as preparedness standard 121
 preparedness resources 306
 principles 14–15
 research — responding personnel 563–4
price gouging 488
primary blast injury 255–7
primary contamination 266
primary events 584
‘prime boost’ vaccination 411
priority setting 132–3
privacy 283, 290–1, 453
private sector business 336–7, 500–1
private voluntary organizations (PVOs) 358
probability (risk component) 18, 19
problem solving counseling 464
problem-solving skills 6, 7–8
procurement unit (of HICS) 173

INDEX

prodromal phase (of ARS) 241–2
 Project Alert 135
 Project Impact 36
 Promoting Action on Research Implementation in Health Services (PARIHS) project 568
 prophylaxis 412, 434
 protein-energy malnutrition (PEM) 440
 Prussian blue (PB) 246
 psychological debriefing 459–60
 psychological first aid 463–5
 psychological responses (children) 310–11
 PTSD *see* Post-Traumatic Stress Disorder
 public health incident command 180–1
 public health insurance 530–1
 public health response 385–95
 Public Health Service 358
 Public Health Service Commissioned Corps 126
 public information officers (ICS) 167
 Public Information System (PIS) 179
 public relations 134–5
 PVOs *see* private voluntary organizations

Q
 qualitative research (research approach) 576
 quarantine 393–4, 406, 408, 417, 488–9
 quaternary blast injury 259

R
 rad (radiation unit) 224, 225, 232–3, 241, 244
 radiation
 emergency management of radiation injuries 221–49, 252
 exposure versus contamination 223–4
 nursing management of radiation incident victims 227–40, 273
 population monitoring 248–9
 and potassium iodine 318
 radiation basics 222–5
 radiation dose and units of measurement 224
 radiological and nuclear incidents 225–7
 treatment of internal contamination 245–8
 types of radiation 223
 Radiation Emergency Assistance Center/Training Site (REAC/TS) 234, 239, 244, 246, 247, 254
 Radiation Emergency Planning and Assistance Network (REMPAN) 246, 247, 252
 Radiation Event Medical Management (REMM) 252
 radiation exposure device (RED) 225–6
 radiation sickness *see* acute radiation syndrome
 Radiation Treatment Area (RTA) 228, 229, 238
 radiography 256
 radiological attacks 225–7, 377–8, 379–80
 radiological dispersal device (RDD) 226
 radiology 112, 261
 Radiology and Computerized Axial Tomography (CAT) departments 94
 radionuclides 245
 radiosensitivity 224–5
 railway (transportation) 160
 randomized, controlled trials (RCT) 569–70
 rapid diagnostic tests (RDTs) 312
 rationing 132–3
 RDTs *see* rapid diagnostic tests
 REAC/TS *see* Radiation Emergency Assistance Center/Training Site
 ready-to-use therapeutic food (RUTF) supplements 442
 record-keeping 93

recovery (disaster management phase) 9–10, 16, 419–20, 495–508, 542–3, 564–5, 588–90, 593
 RED *see* radiation exposure device
 Red Cross *see* International Committee of the Red Cross
 ‘red’ dependency (electrical power) 145
 redundancy planning 109–10, 130
 refugees 105, 356, 371, 428, 433
 Regional Emergency Medical Services 330
 regional planning 323–32, 334
 Regional Unified Command Structure (RUCS) 327
 relief response (disaster management phase) 9, 16, 588–90
 rem (radiation unit) 224
 REMM *see* Radiation Event Medical Management
 REMPAN *see* Radiation Emergency Planning and Assistance Network
 reporting systems 205–6
 requisitioning (supplies) 128
 rescue 353, 355, 519
 research (disaster nursing) 561–79
 broader and more effective research and evidence-base for disaster nursing 565–72
 challenges 562–2
 disaster research awareness 566
 gaps in research 578–9
 methodologies 574
 objective 572
 research approaches 572–8
 research framework 566–8, 583–97
 Reserve Officers’ Training Corps (ROTC) 541
 resilience 120
 resources
 accessible disaster resource centers 302
 age-specific resources 305
 asset distribution 327–8
 communications resources 305–6
 coordination of resources 52
 demand for 212–13
 ICS and single resources 169
 partnerships and resource sharing 126
 prioritizing resource allocation 479–80
 provision of resources—triage 60, 61, 112–14
 resource management 114–16
 resources and information—radiation injury 252
 resources unit (of HICS) 173
 scarce resources 132–4
 supplies in a pandemic 417
 US federal resources 318, 335–49
 respiration 65, 66, 68
 respirators 277, 278, 414, 415, 416, 417
 response agencies 429
 response planning 336–8
 community, private sector business, and non-governmental organizations 336–7
 federal government 338
 individuals and families 336
 local government 337
 research related to health system communication and collaboration 564–5
 state government 337–8
 timelines 338
 resuscitation 59, 62
Rettungshelfers (RH) (EMS title) 42
 reunification 104–5
 Revised Trauma Score (RTS) 65–6
 ricin (biotoxin) 203, 211, 218
 rinse-wash-rinse decontamination process 275
 risk 17, 33, 140, 362, 383, 407, 536

- chemical risks 185–6
 - and hazard-vulnerability analysis 18, 19
 - and hospital preparedness initiatives 25–6
 - and the Incident Command System 166
 - and rapid worldwide spread of a pandemic 404
 - risk analysis and disaster response activation 193–4
 - risk and redundancy 109
 - risk categories for influenza exposure 416
 - risk modification 586
 - of suicide attempts 462
 - see also* duty to care; special needs populations
 - Roentgen (radiation reading) 233
 - ROTC *see* Reserve Officers' Training Corps
 - RTA *see* Radiation Treatment Area
 - RTS *see* Revised Trauma Score
 - RUCS *see* Regional Unified Command Structure
 - runners 106–7, 109
- S**
- safety 89, 124–5, 445, 463, 524
 - Alzheimers Association Safe return program 295
 - and decontamination training 270–1
 - and incident command 142
 - the Planning and Safety Committee 140
 - research — responding personnel 563–4
 - as response challenge 362
 - safe and resilient hospitals 25
 - and state government 337–8
 - safety officers (ICS) 167
 - salt solutions 435
 - sanitation 434, 437–9
 - sarin nerve gas 183, 186, 187, 194, 195, 197, 267–8, 273
 - SARS *see* Severe Acute Respiratory Syndrome
 - schooling 454–5, 500
 - scientific enquiry 392–4
 - screening centers 208–9
 - Screening Positions (decontamination) 280
 - scurvy 438
 - search and rescue 353, 355, 519
 - SEARO *see* Southeast Asia Regional Office
 - seasonal flu 398–9, 400
 - Secondary Assessment of Victim Endpoint system 67, 69
 - secondary blast injury 257–9
 - secondary contamination 266, 267–8, 383
 - secondary event 584
 - sectorial training kits 380
 - security 36, 92, 102–6, 172, 280, 338–9, 387–8, 417–18
 - security branch (of HICS) 172
 - self-efficacy (characteristic) 463
 - 'sentinel events' 391
 - sequential organ failure assessment [SOFA] score 76
 - service animals 293–4, 305
 - service branch (of HICS) 172
 - services 42–9, 296–7, 500–1
 - Severe Acute Respiratory Syndrome (SARS) 203–4, 207, 208–9, 211, 212, 336, 387, 389
 - and descriptive studies 575
 - and duty to care 481–2
 - and ethical decision-making 486
 - and infection control 414–16
 - severe mental disorders 465
 - sewage system 147
 - sexually transmitted infections (STIs) 437, 438
 - SHA *see* Supreme Health Authority
 - shelters/shelter seekers 105, 123, 316–17, 434–5, 443–4, 453, 499–500, 518
 - accessible shelters 301–2
 - disaster preparedness for pets 293–4
 - and Hurricane Katrina 538–9
 - and risk of tuberculosis 436
 - Special Needs Shelters 297
 - temporary external shelter 123
 - Shigellosis (Shigella dysentery) 438, 446
 - shock waves 255
 - showering (decontamination process) 236–7
 - Sieve and Sort triage system 64–6, 77, 312
 - Sievert (radiation unit) 224
 - Sigma Theta Tau International Society 556
 - simple incidents 142
 - simulations 23, 380
 - SIT *see* Stress Inoculation Therapy
 - situations unit (of HICS) 173
 - skills
 - critical thinking 6, 7
 - problem-solving skills 6, 7–8
 - staff skills level as EMS basis 42–4
 - sleep disturbances 311, 316–17, 450, 456
 - SLUDGE 186, 188
 - smallpox 202, 203, 212, 213, 216, 389
 - SNRs *see* Special Needs Registries
 - SNS *see* Strategic National Stockpile
 - social activities 32–3
 - social capital 35, 496
 - social distancing 408–9
 - solid waste management 285
 - SOPs *see* standard operating procedures
 - Southeast Asia Regional Office (SEARO) 522
 - Southeast Asia tsunami 513–26
 - baseline healthcare infrastructure and services 514
 - challenges 523–4
 - earthquake and tsunami impact 514–16
 - emergency and public health considerations 517–19
 - lessons learned 524–5
 - responses 519–22
 - Southeastern Regional Pediatric Disaster Response Network 540
 - Spalling effect 255, 256
 - special needs populations 289–303, 418, 539–42
 - identifying and registering needs 290–1
 - lessons learned 289–90
 - needed services 296–7
 - sources of data and resources 305–6
 - strategies 297–302
 - see also* advocacy agencies; vulnerable groups
 - Special Needs Registries (SNRs) 290–1, 295, 297, 298–9, 300
 - Sphere Project 429–30, 454–5, 497, 498
 - spine boards 156
 - St. Jude Children's Research Hospital 541
 - staff (disaster response measure) 21–2, 121–2, 123–8, 135, 326
 - credentialing and liability 127, 168, 328–30, 331, 522
 - disaster staffing 89–91, 283
 - surge staff capacity 124–6
 - triage area personnel 92
 - volunteers 36, 51, 126, 127, 503, 522
 - staging location (sector) 46, 159, 540
 - staging manager (of HICS) 172
 - standard operating procedures (SOPs) 381
 - START triage system 66, 312
 - steam system 146
 - sterilization 146, 231, 244
 - STIs *see* sexually transmitted infections
 - stockpiles (of supplies) 128, 412, 417, 418, 587

INDEX

- Strategic National Stockpile (SNS) [pharmaceuticals] 88, 128, 247, 318, 347, 541
 stratification (patient) 133
 Stress Inoculation Therapy (SIT) 97, 458
 stress/stressors 96–7, 427, 459, 452–3, 468–9
 stretchers 155
 Strike Team Manager (decontamination) 280
 strike teams 169
 structural vulnerability 17–18
 structure (disaster response measure) 22, 121–2
 stuff (disaster response measure) 22, 121–2
 suction system 146
 sufficiency of care 133–4
 suicide 258–9, 376, 377, 533
 supervisors (ICS) 168, 169
 supplies 22, 135, 327–8, 342, 417
 blood products 88, 133, 242, 244
 disruptions to oxygen supply 143
 ED supplies and equipment 86–8, 91–2
 essential supplies disruptions 150–1
 exchange carts 92
 immediate supplies 115–16, 523
 inadequate medical supplies 404–5
 pediatric hospital supplies 317
 for pediatric patients 541
 pharmaceuticals lists 87–8, 127–8, 327–8, 541
 relief supplies 521–2, 523
 requisitioning 128
 stockpiles 128, 412, 417, 418, 587
 support branch (of HICS) 172
 supportive care 432
 Supreme Health Authority (SHA) 378
 surface envelope glycoproteins 398
 surge capacity 120–8, 382, 563–4
 surveillance 386, 388, 389–92, 434, 519, 576, 595
 surveys (radiological) 232–3, 234, 237
 sustainability (of healthcare operations) 211–13
 swabs (nose/mouth) 234
 swine flu 400
 syndromic surveillance 386
 systematic reviews (research approach) 574–5
 systemic poisons 186–90
 systems (hospital systems) 143–7
- T**
 tabletop drills 23, 380
 Task Force on Quality Control of Disaster Management 583–97
 task forces 169, 583–97
 TB *see* tuberculosis
 TBI *see* traumatic brain injury
 TBSA *see* Total Body Surface Area
 telecommunications 106–11, 300
 see also communications
 Telecommunications Relay Services (TRS) 300
 teleological ethical decision-making approach 474–5
 telephone hotlines/counseling 410
 terrorism 102, 253, 376
 biological agents 199–213, 216–20
 and blast injury 258–9
 burden of terrorism in Israel 377
 chemical terrorism 184–5
 emergency management of terrorist events 377–8
 as response challenge 360
 see also bioterrorism
 tertiary blast injury 259
 Texas Children's Hospital 540, 542
- text telephones (TTY) 300
 three Ss (disaster response measures) 21–2
 time unit (of HICS) 173
 timelines 338
 tissue irritants 190–2
 Total Body Surface Area (TBSA) 260
 tourists 515, 523
 toxicological attacks 377–8, 379–80, 382–3
 tracking (patient)/tracking systems 81, 104, 157–8, 284, 315, 534
 'tragic choices' 485
 training 22–5, 36, 76, 541
 ALS and BLS comparison 43
 challenges 23
 cross-training 125–6
 decontamination training 22, 270–1
 disaster nursing educational competencies 549–56
 just-in-time training 553
 medical personnel in Israel 379–80
 research—responding personnel 563–4
 transactional societal framework 590
 transfer (of patients) 114, 123, 157–8
 see also tracking (patient)/tracking systems
 translational research 573
 transportation (sector) 46, 49, 62–3, 81, 92
 accessible transportation 301
 ambulance services 42–9
 Angel One air transport 540
 carrying methods and transportation devices 155–6, 284
 EMS transportation difficulties 47–8
 during evacuation 159–60
 and relief supplies 523
 triage practice implications 63
 traumatic brain injury (TBI) 257
 treatment 81, 188
 and drill evaluation 24
 ED alternate treatment areas 94–5
 for explosive events 261–2
 standardized treatment plans 96
 treatment acuity 72–3
 treatment of internal contamination 245–8
 treatment sector — EMS 46
 triage 4, 9, 49, 81, 188, 200, 274–5, 382–3
 algorithms 64, 67, 68, 69–70, 76
 Careflight Triage System 67
 categories 58–60, 62, 65, 94
 in chemical events 195
 and contaminated victims 104
 decontamination triage 280–1
 Decontamination Triage Manager 279
 and drill evaluation 24
 emotional responses and effective triage 69
 EMS triage 45–6, 193, 521
 and evacuation 152
 in-hospital triage 71–6
 implications 75
 and international disasters response 353–4
 issues 76
 Jump Start triage system 67, 69, 70, 312
 Manchester triage system 74–4
 Ontario System of triage 219–20
 and pediatric victims 312–13
 post-decontamination triage 281
 pre-casualty contact 61
 pre-decontamination triage 588–90, 591
 pre-hospital and receiving hospital contexts 58
 re-evaluation and re-triaging 62

- and resource rationing 133
 - reverse triage 57
 - START triage system 66, 312
 - triage practice implications 63
 - see also* disaster triage
 - Triage Officers 92
 - triage tags/cards 70–1, 77, 93
 - triangulated mixed methods (research approach) 577–8
 - tropical storm Allison 161
 - TRS *see* Telecommunications Relay Services
 - tsunami 289–90, 308, 316, 319, 359, 365, 368
 - and mental health problems 455, 468
 - and PTSD 310
 - and recovery 504
 - research 564
 - Southeast Asia tsunami 513–26
 - 'tsunami lung' 521
 - TTY *see* text telephones
 - Tuberculosis (TB) 436, 438
 - Tulane University Hospital 540, 541
 - tularemia 202, 217
 - '2-PAM' (Pralidoxime) 187
 - 2002 Bali Bombings 107, 113, 116, 563
 - two-way radio communication 109, 111, 130
 - tympanic membrane injury 256, 257, 262
- U**
- UCLA PTSD Reaction Index 311
 - UN *see* United Nations
 - uncompensated internal disasters 143
 - under-triaging 62, 63
 - unified command structure (of ICS) 169–70
 - uninsured citizens 530–1, 542
 - United Nations (UN) 25, 26, 135, 356–7, 429, 487
 - United Nations High Commissioner for Refugees (UNHCR) 356, 371, 429
 - United Nations International Children's Fund (UNICEF) 135, 315, 356, 357, 429
 - United Nations Office for Coordination of Humanitarian Affairs (UNOCHA) 370–1
 - United Nations' Universal Declaration of Human Rights 445
 - United States Government Interagency Domestic Terrorism Concept of Operations Plan 339
 - United States military 348
 - United States Public Health Service Commissioned Corps (Commissioned Corps) 347
 - units/unit leaders (ICS) 169
 - Universal Declaration of Human Rights 487
 - UN-OCHA *see* United Nations Office for Coordination of Humanitarian Affairs
 - Urban Search and Rescue teams (USAR) 50–2
 - urgent (yellow) triage category 58, 59, 62, 65
 - US Agency for International Development (USAID) 357
 - US federal resources 318, 335–49
 - additional medical response resources 346–8
 - National Disaster Medical System 342–3
 - national response framework 338–42
 - response planning 336–8
 - teams 343–6
 - US Hospital Preparedness Program 23
 - USAID *see* US Agency for International Development
 - USAR *see* Urban Search and Rescue (US&R) teams
 - utilitarianism 475, 489
 - utility outages 144–7
 - utility-dependency 296
 - Utstein Research Guidelines 565, 567, 572, 597
- V**
- V agents 186
 - vaccine/vaccination 410–11, 417, 433, 438, 518
 - vasodilation 191
 - vector-borne diseases (VBD) 444
 - vendor-managed inventory (stockpiles) 128
 - ventilators/ventilation 145–6, 207, 208, 296, 532
 - Veteran Affairs (VA) system 296, 537, 539–40
 - veterans 539–40
 - Veterinary Medical Assistance Teams (VMATs) 294, 344–5
 - VHF *see* viral hemorrhagic fevers
 - Vibrio infection 536
 - victims
 - and burn units 113–14
 - and chemical preparedness and response 183–97
 - children 307–19
 - and Emergency Medical Services 41, 42–9
 - mass burials of victims 116
 - nursing management of radiation incident victims 227–40, 273
 - pediatric victims needing decontamination 283–4
 - and population monitoring 248–9
 - and pre-decontamination triage 280–1
 - privacy of victims 283
 - Secondary Assessment of Victim Endpoint system 67, 69
 - and USAR teams 50–2
 - victim arrival at the ED 83
 - viral hemorrhagic fevers (VHF) 202–3, 211
 - Vitamin A deficiency 433, 434, 436
 - VMATs *see* Veterinary Medical Assistance Teams
 - volunteers 36, 51, 126, 127, 503, 522
 - vulnerabilities 16–20, 530
 - definition 17
 - developing countries and hazards 496
 - hazard vulnerability assessment 326–7
 - health-vulnerability assessment 334
 - physical vulnerabilities of children 308–9
 - severe mental disorders 465
 - vulnerability reduction 25–6
 - vulnerable groups 418, 488
 - elderly 294–6, 303, 466–7, 542, 564
 - locating 298–9
 - persons with disabilities 292–3
 - service animals and pets 293–4
- W**
- WADEM *see* World Association for Disaster and Emergency Medicine
 - walking wounded *see* non-urgent (green) triage category
 - warm zone (decontamination) 274, 275
 - warmth (children) 316–17
 - warning process model (evacuation) 30
 - waste management 284–5
 - water 130–1, 146–7, 283–4, 434, 437–9, 595
 - contamination 130–1, 437, 439, 517–18
 - potable water 130–1, 434, 595
 - waste water containment 284–5
 - weapons of mass destruction (WMD) event 265, 266, 317–18, 344, 360
 - weather (decontamination issue) 282
 - Weekly Epidemiological Record 390, 391
 - weight (kg)-for-height (cm) measurements 440
 - White House Conference on Aging 298

INDEX

- WHO/Pan American Health Organization (PAHO) 506
 - World Association for Disaster and Emergency Medicine (WADEM) 25, 565, 583–97
 - World Food Programme (WFP) 356, 357, 429
 - World Health Organization (WHO) 25, 184, 246, 247, 252, 356, 357, 371
 - assessment and treatment guidelines for dehydration in children 312, 313
 - child mortality and morbidity statistics 309
 - competency domains 552, 553
 - contingency planning steps 132
 - and epidemiological investigations 392–4
 - guidelines for tuberculosis treatment 436
 - and human rights 487
 - pandemic planning 397–422
 - and public health response 389–90
 - and safety 14
 - and SEARO 522
 - WHO phases versus federal government response stages 402
 - World Trade Center attacks 31–2, 51, 52, 110, 135, 181, 259, 329–30
 - and PTSD 310, 458
 - and special needs identification 290–1
 - waterborne evacuation of Lower Manhattan 29–30, 31–2, 36
 - ‘worried well’ patients 204, 273, 280
 - wound care 432, 517
- X**
- xerophthalmia (blindness) 433
 - x-rays 223
- Y**
- ‘yellow’ dependency (electrical power) 145
- Z**
- zanamivir (antiviral agent) 411–12
 - Zone Managers (decontamination) 280

