2 Hospital Preparation and Response to an Incident

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If supposedly civilized nations confined their warfare to attacks on the enemy's troops, the matter of defense against warfare chemicals would be a purely military problem, and therefore beyond the scope of this study. But such is far from the case. In these days of total warfare, the civilians, including women and children, are subject to attack at all times.

—Colonel Edgar Erskine Hume, Medical Corps, US Army, 1943

1. INTRODUCTION AND BACKGROUND

Hospital-based physicians normally at some time their career study, prepare, and practice skills required to treat mass casualties. The focus traditionally centers on the

From: *Physician's Guide to Terrorist Attack*
Edited by: M. J. Roy © Humana Press Inc., Totowa, NJ

presentation of many patients appearing at the Emergency Department (ED) door with multitrauma as a consequence of a conventional weapon or explosion or a natural disaster. The events of September 11, 2001 (hereafter called 9/11) and the subsequent anthrax cases that year demonstrate that acts of terrorism, including those of chemical or biological agents, have come to the forefront of our daily lives. Current governmental reports predict repeated events over time. Only through intensive education and training can physicians and medical facilities adequately prepare to meet the medical challenges imposed by chemical, biological, radiological, nuclear, and explosive (CBRNE) weapons of terror, commonly knows as weapons of mass destruction (WMD). Much work lies ahead, for over 70% of hospitals may not be prepared to handle such incidents *(1)*, and only 20% have any plans for handling biological or chemical incidents *(2)*.

2. DISASTERS AND MASS CASUALTY INCIDENTS

Disasters occur when normal, basic services of a society become disrupted to such an extent that widespread human and environmental losses exceed the community's emergency management capacity *(3)*. Disasters normally imply involvement of a large geographic area with many casualties. However, "disasters" should be distinguished from "mass casualty incidents" (MCIs), defined as "... events resulting in a number of victims large enough to disrupt the normal course of emergency and health care services of the affected community" *(4)*. Disasters, then, typically result in MCIs but encompass a broad range of calamities to society beyond high numbers of patients or casualties.

Disasters and MCIs in the medical literature have typically been described as arising from internal (that is from within the health care facility) or external causes. Terrorism is a man-made, external disaster and serves as the focus for this study.

3. DISASTER RESPONSE IN THE UNITED STATES

Recent disaster response in the United States dates to the 1964 earthquake in Alaska, when needs far exceeded local capabilities. Governmental review led to development of the Disaster Relief Act in 1974 that outlined the law and procedures for state governors to request formally federal assistance. As a follow-on, the Federal Emergency Management Agency (FEMA) was created in 1979 primarily in response to the needs of the Cold War; by 1989, however, it became empowered and funded to focus its efforts on other disaster responses as well. The current basis for federal disaster response in the United States is PL 93-288 (and later amended in PL 100-707), the Robert T. Stafford Disaster Relief and Emergency Assistance Act (most commonly known as the *Stafford Act*) *(5)*.

Under the guidance of FEMA, the response to a federally declared disaster within the United States, known as the Federal Response Plan (FRP), is divided into 12 functional areas called Emergency Support Functions (ESFs; *see* Table 1). Hurricane Andrew in 1992 saw the first use of the FRP. In such a disaster, FEMA provides overall direction to the lead and support agencies within each ESF. However, fundamental to the federal disaster response is that the federal assets deploy to assist and coordinate with the state government, which maintains overall responsibility for any disaster within its boundaries *(5)*.

Beginning in 1980 as the Civilian-Military Contingency Hospital System (CMCHS), the national response for mass medical needs was designed to increase the number of beds available to the military health care system in times of emergency. Following a 1981 review of the federal disaster response to the eruption of Mt. St. Helens, the National

Table 1
The 12 Emergency Support Functions

Function	*Lead agency*
1. Transportation	Department of Transportation
2. Communication	National Communication System
3. Public works/engineering	Deptartment of Defense (U.S. Army Corps of Engineers)
4. Fire fighting	Department of Agriculture
5. Information/planning	Federal Emergency Management Agency (FEMA)
6. Mass care	American Red Cross
7. Rescue support	General Services Administration
8. Health and medical services	Department of Health and Human Services (now Department of Homeland Security)
9. Urban search and rescue	FEMA
10. Hazardous material	Environmental Protection Agency
11. Food	Department of Agriculture
12. Energy	Department of Energy

From ref. 5.

Disaster Medical System (NDMS), under the lead of the Office of Emergency Preparedness (OEP) in the Department of Homeland Security (DHS) (formerly in the Department Health and Human Services; DHHS), replaced and updated the CMCHS. NDMS also includes the Department of Defense (DOD), the Department of Veterans Affairs (DVA), and FEMA. OEP, in addition to providing overall direction to NDMS, also oversees the development, training, and implementation of Disaster Medical Assistance Teams (DMATs) and other specialty teams. DOD assists in transportation and medical support, DVA provides physical facilities and medical supplies at the disaster site, and FEMA aids with personnel, training, and funding *(5)*.

Under ESF 8, DHS/OEP has responsibility for:

1. Assessment of health and medical needs
2. Surveillance of health care issues
3. Acquisition and distribution of medical personnel
4. Acquisition and distribution of health and medical equipment and supplies
5. Medical evacuation
6. Inpatient care
7. Food/drug/medical-device safety
8. Worker health and safety
9. Radiological monitoring
10. Chemical or Hazmat monitoring
11. Biological monitoring
12. Mental health assessment
13. Development and dissemination of public health information
14. Vector control
15. Water and sewage management
16. Victim identification and mortuary services *(5)*.

The 61 DMATs and specialty teams that OEP supervises come from across the United States, each normally sponsored by a local civilian agency, such as a regional trauma center. Approximately 35 volunteer medical and support personnel are deployed with

each team. When designated "on call" through a rotating schedule, team members must be prepared to deploy within 12–24 hours of notification, be self-sustaining for 72 hours, treat 250 patients, and remain on location for 10–14 days. In addition to providing both general surgical and medical capabilities, several specialty teams (e.g., burns, pediatrics, and so on) can also be generated and deployed. During the mission, team members become federal employees, although their task is primarily to interface with and support local medical systems *(5)*.

4. DISASTER EFFECTS ON HOSPITALS

4.1. Historical Data

Mass casualties, particularly from sudden impact explosions or detonations, result in a predictable set of injuries and circumstances surrounding the event. Many of the lessons learned from previous disasters were discussed in Chapter 1 of this guide. Review of these historical precedents will prove to be invaluable in preparing physicians and facilities for the medical consequences of a terrorist event.

One major study from 1988 reviewed 14 reports of terrorist bombings from 1969 to 1983 *(6)*. The review included information on 220 worldwide incidents that caused 3357 casualties. In these events, the average number of victims was 15.3 casualties/incident. Four hundred twenty-three (12.6%) persons died before receiving any medical care. However, 2934 (87%) of the victims survived the immediate event; of these, 881 (30%) were admitted. Forty (1.4%) of the immediate survivors eventually died. Of the 1339 casualties with sufficient data to review, 18.7% were deemed critical (range 7.6–34%), and 45.5% were admitted. Overtriage (defined in this paper as the "proportion of noncritically injured survivors hospitalized for immediate care") was 59% (range 8.3–80%). Conversely, there was only one single case of possible undertriage. Head injuries were the predominant cause of immediate (71%) and late (52%) deaths. Records of 812 survivors showed that the surgical procedures were categorized as soft tissue in 67%, bone in 17.5%, abdominal in 5.5%, head in 2%, and miscellaneous in 8%.

The impact of these types of terrorist bombings on hospitals has most recently been described in the Oklahoma City bombing which occurred on April 19, 1995. A detailed retrospective review of medical examiner records, hospital records, physician surveys, and building occupant and survivor surveys, as well as ambulance dispatches, media reports, and several other sources were used in one study to look at the injury and fatality patterns from the blast. The blast injured a total of 759 persons, of whom 167 died (case fatality ratio of 22%); 162 deaths occurred at the scene, three persons were dead on arrival at the emergency room, and two persons died of wounds on days 2 and 23 following admission. Of the remainder, 509 were treated as outpatients and released (67% of the injured or 86% of the immediate survivors), and 83 were hospitalized (11% of the injured or 14% of the immediate survivors). The injuries were primarily soft tissue lacerations, abrasions, contusions, and punctures (74% to the extremities, 48% to the head, 45% to the face, and 35% to the chest) and musculoskeletal injuries (the most common fracture sites were the extremities, face and neck, back, chest, and pelvis) *(7)*.

Another study that looked at the Oklahoma City bombing evaluated the impact on the EDs in the city through a retrospective review of 388 available medical records at 13 hospitals *(8)*. Following the explosion, the median time to arrival at the emergency department was 91 minutes, with most making it by 3 hours. Patients who eventually were

admitted to the hospital took longer to get to the ED than those who were treated and released. The mode of transportation was 56% by privately owned vehicle, 33% by emergency medical services, 10% by walking or being carried, and 1% by other means.

Most (64%) of the patients who were treated in the field were admitted to the hospital: 28% to the operating room, 24% to a ward, and 9% to the intensive care unit; 3% were dead on arrival. Once a patient was seen in the ED, the contact time was approximately 1 hour. The five most common procedures conducted in the ED were wound care, tetanus immunization, intravenous line placement, pulse oximeter use, and the administration of analgesics. For patients discharged from the ED, the most common diagnoses were laceration (30%), contusion (9%), fracture (8%), strain (6%), head injury (6%), and abrasion (6%).

Most of the literature surrounding the medical effects of terrorism focuses on the more frequently used conventional weapons or explosions. The most publicized use of chemical agents for terrorism occurred in Tokyo in the middle 1990s when on two occasions the Aum Shinrikyo Japanese religious cult released sarin gas. The first release came on June 27, 1994 in the city of Matsumoto and resulted in 600 persons being exposed; 58 of them were admitted and 7 died *(9)*. The more famous and larger event took place in Tokyo on March 20, 1995, when the cult released sarin gas in the subway, resulting in the deaths of 11 commuters and medical evaluation of 5000 persons *(10)*.

4.2. Current Assessment of Hospital Preparedness

Although fortunately no terrorist-related MCI occurred at the 1996 Atlanta Olympic Games, "unprecedented" preparations took place to prepare the community for any medical consequences of a terrorist attack involving WMD. Most local, state, and federal (including military) assets involved in the plan focused on prehospital assessment, diagnosis, decontamination, and treatment. Examples included the establishment of a Federal Bureau of Investigation (FBI) team specializing in the rapid assessment of an incident site, the development of a multiagency Science and Technology Center to provide multidisciplined consultation, the stockpiling of antimicrobials and antidotes, enhanced surveillance, and specialized first-responder training. In addition, augmented clinical capabilities included 30 specially trained DMATs, the U.S. Marine Corps Chemical and Biological Incident Response Force (CBIRF), and the newly developed Metropolitan Medical Strike Teams (MMSTs). In addition to some stand-alone capability, these organizations could also augment or support local medical facilities, many of which developed and exercised their own medical response plans *(11)*.

Since 9/11, the entire nation and the health care infrastructure have embarked on ambitious programs designed to provide medical support to the populace in the event of significant disaster, to include a terrorist-dispersed WMD. Prior to 9/11, lack of hospital preparedness for a chemical or biological terrorist attack was somewhat understandable. In May 2001, fewer than 20% of 186 EDs from four northwestern states had plans for biological or chemical weapons events. Forty-five percent had some decontamination capability, but only 29% could provide enough atropine for 50 sarin nerve agent casualties *(12)*.

Although plans since 9/11 have moved forward with fervor, as reported in November 2001 *(1)*, hospitals continue to believe they are unprepared for such an event. Of 30 hospitals in FEMA Region III (Pennsylvania, West Virginia, Maryland, the District of Columbia, and Virginia) that responded to a survey, 73% believe they are completely

incapable of handling a biological or chemical incident; only urban hospitals (26% of the total) felt somewhat prepared for these scenarios. Preparation for a nuclear weapon was identical, with the exception of a hospital in close proximity to a nuclear power plant. Only 73% of respondents were prepared for patient decontamination (one room only). WMD preparedness was incorporated into the emergency preparedness plans in 27% of the facilities. Finally, only 23% of the respondents reported that their staff had received any WMD training (all lecture-based), and only one metropolitan hospital had conducted mandatory training for its clinical personnel.

Hospital disaster preparedness typically falls under the purview of emergency medicine staff. Hospital and inpatient-based physicians such as intensivists, have only recently begun to expand their role outside the resource-rich intensive care unit into settings that may require triage. MCIs involving terrorism, or more common Hazmat incidents, will necessarily involve these physicians and may require them to play a role in the triage and prioritization of limited inpatient resources. Unfortunately, "training in disaster management, including Hazmat incidents, is not part of training guidelines for intensivists" *(13)*.

5. PREPARATION

5.1. Disaster Response Plans

Disaster medicine has its own literature that, through an evidence-based approach, may be useful in disaster planning. The consequences of disasters, particularly those resulting from explosive devices, are often predictable, based on information such as that given in Subheading 4.1. above. However, the use of that information to prepare a medical response often becomes problematic, particularly as the response broadens and crosses departmental and agency boundaries. "Most disaster response problems are not failures of the individual. More often they are *system problems*. That is, the usual organizational systems (procedures, management structures, and designation of responsibilities) established by various organizations to cope with routine, daily emergencies are not well adapted for use in disasters" *(14)*.

Unfortunately, little has been written about such system faults. Coordination among agencies and their communication of information is usually the biggest problem facing a multiagency disaster response. For example, when a mock extortionist threat to detonate a nuclear device at the Summer Olympics in Atlanta was used in a multiagency exercise in 1994, major weaknesses were identified in the cooperation between agencies whose priorities and incentives conflicted. In this exercise, the FBI focused its efforts on identifying and capturing the terrorists, whereas the Department of Energy and DOD were most concerned with disabling the bomb *(15)*.

Sudden impact disasters, such as a terrorist bombing, can be thought of as occurring in a time sequence of five phases: (1) interdisaster; (2) predisaster or warning; (3) impact or detonation; (4) emergency response or relief; and (5) rehabilitation or reconstruction *(16)*. Development of a comprehensive response plan should take place following such a disaster, during the rehabilitation phase, or prior to the next one (the interdisaster phase). The interest in generating such a plan is "… proportional to the recency and magnitude of the last disaster" *(14)*. Notably, this is also the best time to submit plans for funding.

Unfortunately, once the reconstruction is well under way, such planning begins to wane. "People are unlikely to give priority attention to an unlikely future disaster when there are fifteen tasks to be accomplished by Friday" *(14)*. This perspective, in the current setting of limited governmental resources, often results in an apathetic response to disaster planning. Thus, to accomplish such a task, disaster preparedness proposals must be cost-effective.

Planning in detail for a disaster and all its possible outcomes is an overwhelming task that is doomed to incompletion. In contrast, disasters of moderate size have a better chance of funding, are more likely to be rehearsed, and have a higher probability of occurring. Such model disasters should include approximately 120 casualties, for disasters of this magnitude will pose most of the interorganizational dilemmas that occur in larger events. Ideally, the plan and management structure should allow for a modular expansion of response "… as the incident (and the number of resources that need to be coordinated) grows in size" *(14)*.

Hospital disaster planning often faces significant challenges because the task is complex, time-consuming, and often relegated as an "additional duty." Designated persons tasked to develop a hospital plan need experience, patience, and a detailed understanding of the organizational personalities in order to foster cooperation in developing the plan. Additionally, the planner must ensure that the anticipated workload is appropriately divided for optimal use of critical specialties *(17)*.

5.2. Notional Plans

Once the intent to develop a plan matures and becomes a priority for an organization, what ensures its successful application when the disaster occurs? Unfortunately, planning for a disaster response is merely an illusion unless "... it is based upon valid assumptions about human behavior, incorporates an inter-organizational perspective, is tied to resources, and is known and accepted by the participants" *(14)*. The written product, although a template for action, fails to demonstrate adequate preparation unless it is accompanied by training. Through training, the plan validates what people are "likely" to do rather than what they "should" do *(14)*.

Although disaster planning is fraught with a multitude of challenges, "… the *process* of planning is more important than the written product that results" *(14)*. The personal contacts and familiarity of individuals within the organizations participating in the disaster planning all contribute to a modicum of success. Unfortunately, with the frequent turnover of individuals within the organizations, particularly at the federal level, the mistakes of past disaster responses often recur.

The medical literature pertaining to disaster preparedness planning is primarily focused on the community level. However, principles of good preparedness planning that apply to the prehospital environment are also valid for hospital disaster plans. A common 10-point approach includes the following *(18)*:

1. View disasters as quantitatively and qualitatively different from accidents and minor emergencies.
2. Plan as a continuing process rather than focusing on an end product such as a written plan.
3. Look at a multihazard, generic plan rather than an agent-specific plan.
4. Focus on the coordination of emergent resources rather than a fixed command and control structure.

5. Look at general principles rather than specific details.
6. Assume that potential victims (and staff) will react well during a crisis.
7. Emphasize the need for intra- and interorganizational integration during the development of the plan.
8. Anticipate likely problems and possible solutions.
9. Plan according to disaster data rather than personal anecdotes or "war stories."
10. Plan according to phase (mitigation, preparedness, response, and recovery).

6. DISASTERS VS EMERGENCIES

Every organization plans for, and often experiences, a variety of emergencies, yet disasters usually stress normal organizational structure and procedures beyond their design capabilities. Table 2 delineates some common differences between routine emergencies and disasters.

7. INTERAGENCY COOPERATION

Interagency communication and coordination challenge normal emergency responses in disasters. Most agencies tend to model their organizational and emergency responses along the typical military model of command and control, that is, centralized control under a single commander and decentralized execution. However, "... realistic disaster management in a country with a decentralized government such as the United States, with its traditional preferences for local control and private enterprise, probably cannot be accomplished using a military model, rather, coordination among various independent responding organizations needs to be based on negotiation and cooperation" *(14)*.

The cooperation needed in disasters is best demonstrated in the development of predisaster planning with parties of all agencies, emergency operations centers, and the Unified Command structure of the Incident Command System or Hospital Emergency Incident Command System (HEICS). Efficient disaster response and multiagency cooperation develop by conducting joint planning and training, coordinating the division of labor and responsibilities, agreeing to common communication terminology and procedures, and fostering informal contacts. Knowledge and comfort with others in the disaster-response team promotes an opening of communication regarding glitches in terminology, equipment, and, most importantly, the desire to share critical information ("who else needs to know?"). It is these less-formal procedures that advance an effective disaster response; pre-existing personal, political, and jurisdictional disputes (more commonly known as "turf" or "sandbox" issues) impede multiagency cooperation *(14)*.

8. EXERCISING THE PLAN

Rehearing the disaster plan helps to identify potential areas needing improvement or revision and increases the likelihood of success in a real event. Exercises can range from simple desktop discussions to community-wide drills; the more involvement and interagency cooperation, the more meaningful the event. Unfortunately, these drills tend to infrequently, occur without full participant involvement, and fail to test the plan fully; in effect, a false sense of security develops *(17)*.

Hospitals in Israel often run vigorous rehearsals in order to improve their response efforts to frequent, recurring disasters. Between 1986 and 1994, 30 detailed chemical practice drills were conducted in 21 major hospitals. Each exercise involved the treatment

Table 2
Differences in Disasters

Routine emergencies	*Disasters*
Interaction with familiar parties	Interaction with unfamiliar parties
Familiar tasks/procedures	Unfamiliar tasks/procedures
Intraorganization coordination	Intra- and interorganization coordination
Intact communications, roads, and so on	Disrupted communications, blocked roads, and so on
Intraorganizational communications	Interorganizational communications
Familiar terminology	Unfamiliar, organization-specific terminology
Local press attention	National/international media attention
Management adequate for resources	Resources overwhelm management capacity

From ref. *14*.

of 100–400 simulated patients and included the use of personal protective equipment and decontamination with 25% of the patients including children and adults who required intensive care and ventilatory support. Hospital- and community-wide plans that arose from this exercise included the following principles:

1. Hospital designation: specific hospitals remote from the event should be designated to receive only chemical casualties
2. Optimal use of manpower
3. Preventing hospital contamination
4. Blocking free access to the hospital
5. Triage: using experienced emergency personnel according to chemical, age, and medical criteria
6. Extension of nurses' authority: expanding diagnosis and treatment using established treatment protocols *(19)*

8.1. Roles

The urgency of disasters or MCIs coupled with medical providers' desire to serve and care for the injured potentially leads to conflicts in roles and responsibilities. Health care providers possess a unique skill set, based on their core training and subsequent experiences. These competencies affect how each responds to the stressful event played out in an MCI. In general, providers should care for the victims of a disaster in the environment in which they normally practice medicine. Although each disaster is unique, requiring innovation and adjustment, several basic rules of role assignment apply:

1. Prehospital medics, corpsmen, EMTs, and others should perform the initial assessment, triage, stabilization, and evacuation to the casualty collection and treatment point, where the first physician should intervene.
2. Only physicians, nurses, and other providers specially trained to work in the field, prehospital environment should do so.
3. Only if excess physicians or hospital-based providers exist should they move forward to the disaster scene.
4. Medics or prehospital personnel are poor replacements for nurses or hospital-based providers.
5. Physicians and nurses are better prepared than most to care for the public health needs of the affected population *(20)*.

9. PERSONAL PROTECTIVE EQUIPMENT

No universal personal protective equipment (PPE) recommendations can be made for all potential scenarios. However, PPE recommendations can be standardized by category. Level C protection, that, is full-face mask with a powered or nonpowered canister filtration system and associated chemical barrier suit, is probably adequate for most health care workers. This especially applies to those workers remote from the scene whose only exposure will be to those agents that remain on skin and clothing of the exposed victims *(31)*. Specific biological and infectious control measures have been detailed elsewhere *(34)*.

10. PUBLIC RELATIONS

Problems with the media often result from failure to plan for their presence and involvement. They will be present, so failing to plan for media relations predisposes to problems that could disrupt the disaster response. Normally the media will always want the same information, i.e., casualty information, property damage, disaster response and relief activities, other characteristics of the crisis, and theories on the cause of the disaster *(14)*.

Effective media management in a disaster follows several important concepts. The first is that both the media and the public view silence, or not releasing information, with suspicion. Information must be released as soon as feasible, especially within the first 24 hours. Once the site is safe, access to it becomes a goal for the media and needs to be granted as soon as possible. Speculation and opinion by spokesmen results in mistrust by the media and their audience; questions that cannot be truthfully answered should be researched before release. Finally, after the media begin to release their story, the leadership of the response effort must monitor both the truthfulness of the story and the reaction by the audience *(21)*.

11. FACILITIES

The baseline hospital preparation for a terrorist event will most likely be compliance with those standards of disaster preparedness established by the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO). The JCAHO disaster preparedness requirements fall mostly under the Environment of Care (EC) standards. EC 1.4 requires that plans address four major disaster phases: mitigation, preparedness, response, and recovery. It also requires plans to address evacuation of the facility while establishing alternate care sites. Finally, it mandates a plan that is integrated with other efforts in the community *(22)*.

Hospitals need to approach disaster planning on a regional level to ensure that all patients receive appropriate care within the constraints of community capabilities. Civilian hospitals should communicate with military treatment facilities (MTFs) and develop a cooperative planning relationship. In addition to added treatment capabilities, MTF staffs have often undergone extensive training in preparing for the care of victims of a WMD event and can aid in community preparation. They often also have designated teams specially prepared to handle such MCIs. Capabilities may include agent detection, decontamination, trauma management (which can be rapidly exported), evacuation, mental health support, and communications or logistical support.

Civilian hospitals may also have well-established relationships with local Veterans Health Administration (VHA) facilities. Although normally viewed as a resource accessible only to military veterans, these clinics and hospitals will most certainly be used in times of disaster. The VHA has four statutory missions that clearly transcend boundaries in time of need: provide medical care to eligible veterans, train health professionals, conduct research, and support the Departments of Defense and Health and Human Services during times of national emergency. Additionally, the VHA could assist local WMD preparedness planning by:

1. Providing WMD and disaster health professional training
2. Assessing and assisting local and regional planning efforts through the use of its VHA Area Emergency Managers
3. Planning to deliver direct health care in its fixed or mobile facilities, assisting with decontamination and patient staging, and giving other support to often fiscally strapped private hospitals
4. Assisting in the storage and distribution of national stocks of pharmaceuticals, vaccines, and so on
5. Cooperate with other local, state, and federal disease surveillance systems, which may prove useful in detecting a bioterrorism event
6. Conducting ongoing research and implementing proven treatment or preventive strategies in such disaster-related topics as post-traumatic stress disorder and environmental hazards *(23)*

Finally, hospitals can best plan and prepare for disasters by following several selected principles. The first is to develop strategies that overcome the normal resistance to preparedness. This may best be handled by planning for what is likely in the hospital's location, and then, in order to prepare for the less likely, developing procedures for planned improvisation. Second, the hospital and its Emergency Operations Center (EOC) need to ensure that the medical response facilities (or capabilities) will survive and function. Third, the hospital must participate in community-wide disaster planning and training. Communication reliability is always threatened in disasters, so communications strategies not involving the telephone must be planned and exercised. All plans should allow for modular expandability. As so often happens, the plan must consider large numbers of unsolicited volunteers and donations. Finally, especially in a WMD release, the hospital must know how to integrate into state and federal response plans *(24)*.

12. EDUCATION AND TRAINING

The events of 9/11 have clearly changed the focus and expanded the requirements for education on the effects of WMD. Nevertheless, to date, medical education has been unprepared for such events. In 1998, 76 emergency medicine residency program directors noted in a survey that 53% of their residencies did include formal training in bioweapons, but most of that was in lecture format. More (84%) included training in Hazmat or chemical agent release, but, again, most of that education took place in lecture format. Rarely did their training for these events include practical or "field" exercises, and only half the respondents knew about personal protective equipment in the ED *(25)*.

Formalizing medical training for WMD events, for all levels of providers, will greatly prepare health care workers and facilities to respond to such events. Prior to the 9/11 tragedies, a task force of health care professionals looked at this need and reported their

recommendations for such training. These awareness and performance objectives provide a framework on which facilities and educational organizations can base their education and training program *(26)*. Awareness objectives of the educational program included:

1. Terrorism
2. Event types
3. Index of suspicion and event recognition
4. Response systems and communications
5. Key elements of a WMD response
6. Personal protection and safety.

These awareness objectives were then matched to performance objectives, tailored to the way the learners will use the information in their roles. Recommended performance objectives included:

1. Event recognition
2. Unified incident command/management structure
3. Response support
4. Safety and protection
5. Decontamination
6. Isolation and containment
7. Evidence preservation
8. Psychological effects
9. Communication and agency interaction
10. Triage
11. Treatment
12. Transportation
13. Recovery operations
14. Fatality management.

13. RESPONSE

13.1. Assessment

Explosive or conventional weapons, and most chemical weapons, will result in the immediate influx of victims and (especially with chemical weapons) even greater numbers of "worried well." Interaction with law enforcement agencies as well as first responders will give hospital personnel good information regarding the event and potential agent. Release of a bioweapon, on the other hand, will probably result in a latency period of hours to days, whereupon patients will begin to appear at EDs as well as clinics and offices. Initial identification will require a process known as *syndromic surveillance* until laboratory confirmation. For example, the Department of Health in Maryland asks that physicians maintain a high level of suspicion for:

1. Gastroenteritis of any apparent infectious etiology
2. Pneumonia with the sudden death of a previously healthy adult
3. Widened mediastinum in a febrile patient without another explanation
4. Rash of synchronous vesicular/pustular lesions
5. Acute neurological illness with fever
6. Advancing cranial nerve impairment with progressive generalized weakness *(27)*.

13.2. Command And Control Issues

All phases of a disaster require direction and oversight. Once a disaster has occurred, hospitals and other health care facilities must establish an EOC. The function, leadership, access, communications procedures, and so on must be clearly identified. The size, location, interaction with reporting staff, and ongoing patient receiving and treatment activities must be coordinated in order to support, not interfere with or complicate, the response effort. A typical composition includes the hospital director, chief of staff, senior nursing supervisor, and representative staff from such organizations as public affairs, engineering, public safety, and secretarial staff (as found in HEICS). In addition to coordinating internal facility operations, the EOC must oversee and direct communications with outside agencies and authorities. Finally, the EOC must be in a secure location and prepared with emergency supplies for continuous operations. In a WMD release, this will require special attention to weather conditions, decontamination operations, and building security *(28)*.

13.3. Security

Hospital security becomes pivotal in maintaining clinical operations in the event of a WMD release. The initial wave of victims or "worried well" that appear at a facility may unknowingly bypass precautionary measures for contaminated casualties until the nature of the event has been clarified. Thereafter, more incoming patients, worried family members, hospital staff on recall, and volunteers will challenge any imposed security measures. In addition, normal police or other security support may be occupied at the scene or elsewhere in the community.

13.4. Intelligence

Prior warning of an event will clearly aid facility and provider response. Although limited by the available intelligence capabilities of law enforcement and other government agencies, sharing of information with medical authorities may not occur, even if valuable information is known. Prior integration of medical planners into local, state, and federal emergency planning and operations organizations builds the necessary trust and familiarity that becomes crucial to effective medical response in time of need. Medical providers and organizations must become familiar with these agencies' operations and must fully understand the sensitive nature of the intelligence information in order to maintain and further encourage incorporation of medical planning into an overall community response to a WMD event.

13.5. Detection

Detection will probably rely on agencies and organizations outside the medical treatment facility itself. The Centers for Disease Control and Prevention (CDC) plan to integrate the surveillance for illness and injury as a consequence of the release of a chemical or biological weapon into other U.S. disease surveillance systems. This will result in a partnering of the CDC with state and local health agencies as well as hospital clinics and EDs, poison control centers, and other health care facilities. In addition, the CDC, the Association of Public Health Laboratories, and their partners will create a multilevel Laboratory Response Network (LRN) for bioterrorism to analyze biological

agents; it will also partner with other federal agencies such as the U.S. Environmental Protection Agency to diagnose chemical agent exposure *(29,30)*.

Unless it is specifically trained and maintained, a hospital-directed detector will probably slow treatment and decontamination procedures. Most treatment will be ongoing while confirmatory tests continue, thus making this equipment best suited to nonhospital agencies *(31)*.

13.6. Decontamination

Ideally, health care facilities should have decontamination capability in preparation not only for a biological or chemical terrorist event, but also the more common Hazmat events. Outdoor shower-like capability best suits most scenarios, obviating the need for ventilation and permitting the influx of large numbers of patients. With additional provisions for inclement weather, maintaining patient privacy, and securing patients' personal effects, these facilities can permit most patients to conduct self-decontamination with a series of showers and soapy water. This setup frees medical personnel to care for injured patients or those incapable of self-decontamination. Plain soap and water rather than 0.5% hypochlorite is the best material for most scenarios. Simply having the patients disrobe may remove 75–90% of any residual agent. Finally, most facilities and government agencies do not require wastewater containment, although water utilities should be notified *(31)*.

13.7. Triage

MCIs caused by a conventional weapon will result in large numbers of wounded patients suddenly appearing at the ED. Experienced surgeons or other physicians who regularly treat trauma victims should meet the ambulances (or other vehicles, realizing that most victims will arrive by their own means) and immediately triage patients. Stein and Hirshberg *(32)* recommend simple division into urgent and nonurgent categories, with additional providers beginning advanced trauma life support for urgent patients. They advocate dividing surgical care into two phases: (1) the initial phase, when casualties arrive, chaos is maximal, and the exact numbers of casualties remain unknown; and (2) the definitive phase. Notably, they recommend that all patients be thoroughly evaluated for the often missed phonal (tympanic membrane) and ocular trauma.

Depending on the nature of the event and surgical demands placed on the receiving hospital, redistribution of patients to other facilities may be considered. This transfer may be to a facility of higher capability or to one with lesser means that can aid in more time-consuming processes such as wound debridement or orthopedic fixation. Blast injuries will also require matching patients in need of ventilatory support with institutions capable of supporting mechanical ventilation and intensive care support *(32)*.

Early in a bioweapon release, triage categories my differ significantly from those of a conventional weapon. One proposed mechanism expands on the triage categories found in conventional epidemics. The SEIR categories include:

1. *S*usceptible individuals (including those with incomplete or unsuccessful vaccination)
2. *E*xposed individuals (those who are infected, incubating, and noncontagious)
3. *I*nfectious individuals (those who are symptomatic and contagious)
4. *R*emoved individuals (those who are no longer sources of infection, i.e., they survive or die from the illness, and their remains are not contagious)

5. *V*accinated successfully (those with confirmed "take" or who have completed a course for immunity" *(27)*.

Most disasters, and especially those involving WMD, can be expected to result in fatalities. In addition to the difficult challenge of declaring patients as "expectant" during multiple stages of triage, handling of the remains must be considered and planned. Remains held at on-scene locations and those in hospital morgues may require special handling and close coordination with law enforcement agencies, for these events will probably be considered as crimes. In addition, normal sensitivities to family members searching for their loved ones, infection control issues, hazardous or contaminated remains, and media inquiries will also require detailed planning *(17)*.

13.8. Infection Control

Until the nature of the event has been defined, a WMD release, particularly a bioterrorism event, may involve infectious patients. Such an event will require external triage to assist in mitigating the effects on hospital personnel and previously admitted patients, as well as isolation of victims themselves *(22)*. Planning for the infection control of such an event will also be required by JCAHO. For example, the hospital's infection control plan must incorporate or separately identify the infection prevention and control measures that will be implemented in an MCI *(33)*. The Association for Professionals in Infection Control and Epidemiology (APIC), in concert with the CDC Hospital Infections Program Bioterrorism Working Group, has developed detailed infection-control plans, templates, and health care facility checklists *(34,35)*.

13.9. Logistic Support

MCIs involving a WMD release will exponentially increase the logistic support necessary to support the medical effort. Planning processes, communications equipment, decontamination equipment and supplies, antibiotics, antidotes, and many other consumables will place significant burdens on individual facilities and communities. Cooperation will be required with a rapid influx of resources from state and federal sources. Such efforts require pre-event planning, coordination, and exercise. The American Hospital Association estimates that an urban hospital called on to treat 1000 biological or chemical casualties will require $3 million in additional funds and supplies during the first 48 hours; a rural hospital responding similarly to 200 patients may still require $1.5 million *(22)*.

13.10. Personnel Issues

Supporting the response effort will require close attention to many personnel issues. These will include attention to the mental and physical health of the workers, attending to the needs of their families, and providing them with the necessary food, clothing or supplies, rest, and respite from the operations. Medical workers will probably continue sustained operations well after the acute event, and hence planning and implementing this "marathon" response becomes critical to maintaining the health of the community.

13.11. Handling Evidence

WMD events will probably involve a criminal act and hence will attract a multitude of agencies for the investigations. At times, the roles, responsibilities, and agendas may

conflict and appear to impede the medical response effort. However, looking at the event from a community response, all agencies must cooperate for the greater good, health, and survival of the community. Medical authorities must plan, understand, rehearse, and implement their actions in concert with law enforcement agencies in order to assist in this process.

13.12. Aftermath

13.12.1. Recovery

Once an event transpires, recovery operations will begin shortly. Foremost will be the need to resume a sense of normalcy for patients and staff. Depending on the scenario, potentially contaminated areas will need to be reinspected to ensure that the areas are safe to reoccupy. The author's personal experience with the Pentagon disaster on 9/11 revealed a host of other environmental or recovery issues that will inevitably require attention:

1. Air quality
2. Worker's current health as a baseline for future workers' compensation inquiries
3. Personal stress issues for the staff
4. Disseminating information using basic principles of risk communication.

13.12.2. Mental Health Support

As discussed in Subheading 4.1., in their detailed review of disasters in the surgical literature, Frykberg and Tepas *(6)* focused primarily on the injury patterns sustained in 220 bombings from 1969 to 1983. However, they noted in their "Lessons Learned" that these events also revealed a great need for mental health support following the disaster. WMD events will only add to that need. Details of this support are given in Chapter 26 and elsewhere in this book. Nevertheless, hospitals and local health care facilities need to be aware of their role in such support, both for acute needs and to prevent long-term sequelae. The actions and resources needed must be planned, rehearsed, and then implemented, with particular attention to the rescuers and health care workers, in addition to victims of the attack *(36)*.

13.13. Community Quarantine

Should a large-scale bioweapon release of an infectious agent occur, large-scale community quarantine may become necessary. Local hospitals, clinics, and individual health care providers will certainly play a role in this event. Fortunately, recent history has not required such action; no large-scale quarantine has occurred in the United States in over 80 years. However, failure to execute—or even rehearse—the procedures for a quarantine has put our processes in jeopardy. A recent national exercise, TOPOFF 2000, revealed the many political, ethical, and administrative challenges that face implementation. It is essential to plan for the possibility of a quarantine that will involve action on the part of local health care facilities in concert with local, state, and federal public health agencies *(37)*.

14. SUMMARY

Future terrorist events will most commonly take place in the community at locations or events that will maximize the effect of the terrorist's action on the public. Although health care facilities and their employees may be the primary target, they will continue

to support the victims in the role they ordinarily play. Health care workers and their institutions have historically provided the life saving and support needed for victims of all disasters, sometimes jeopardizing their own personal safety and well-being. Such support will require additional education, planning, training, and capability expansion, but it can be achieved. This *Physician's Guide to Terrorist Attack* aids in this process.

ACKNOWLEDGMENTS

The author would like to thank LTC Michael Roy, Director, Division of Military Internal Medicine and Associate Professor of Medicine, Uniformed Services University and the U.S. Army Soldier and Biological Chemical Command, (SBCCOM), Aberdeen Proving Ground, for their support and assistance in this endeavor.

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Physician's Guide to Terrorist Attack
Roy, M.J. (Ed.)
2004, XVI, 406 p. 58 illus., 4 illus. in color. With online files/update., Hardcover
ISBN: 978-1-58829-207-0
A product of Humana Press