Disasters and Mass Casualties: I. General Principles of Response and Management

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Abstract

Disaster planning and response to a mass casualty incident pose unique demands on the medical community. Because they would be required to confront many casualties with bodily injury and surgical problems, surgeons in particular must become better educated in disaster management. Compared with routine practice, triage principles in disasters require an entirely different approach to evaluation and care and often run counter to training and ethical values. An effective response to disaster and mass casualty events should focus on an "all hazards" approach, defined as the ability to adapt and apply fundamental disaster management principles universally to any mass casualty incident, whether caused by people or nature. Organizational tools such as the Incident Command System and the Hospital Incident Command System help to effect a rapid and coordinated response to specific situations. The United States federal government, through the National Response Plan, has the responsibility to respond quickly and efficiently to catastrophic incidents and to ensure critical life-saving assistance. International medical surgical response teams are capable of providing medical, surgical, and intensive care services in austere environments anywhere in the world.

Disasters are large-scale destructive events that disrupt the infrastructure and normal functioning of a community or society. They may be natural (eg, earthquakes, tornadoes, hurricanes) or man-made (eg, industrial spills and explosions, structural collapse, terrorist attack). In a large-scale destructive event, the greatest challenge to the medical community is the large number of casualties who require rapid evaluation and treatment, a number that is out of proportion to the available personnel and resources necessary for optimal care. True mass casualty incidents (MCIs) are rare, thereby providing little opportunity for real-time training and experience. There is no provision in medical school or during residency training for the education of physicians in the unique demands and approaches required for the medical care of mass casualties. Disaster planning in most hospitals is rudimentary at best[1,2] and is frequently geared to the minimal passing requirement standards as determined by the United States (US) federal government and the Joint

Commission on Accreditation of Healthcare Organizations.

A string of recent natural disasters has helped to underscore the fact that medical care is only one part of a full disaster response. In 2004, an earthquake demolished the ancient city of Bam in southeastern Iran. More than 30% of its population of 100,000 was killed within a few minutes.[3] In addition to medical aid, the international community was relied upon to provide food, water, and temporary shelter and to help reestablish essential services (eg, sanitation, power, transportation) for the survivors. The international community also worked with the Iranian government to begin the process of urban resurrection by clearing streets and roads, setting up a large medical center to replace the three that were destroyed, and providing other logistical support to help reestablish the city's infrastructure.

All of this was performed through a reasonably well-orchestrated response-management plan that has evolved through experience. Lessons learned from prior disasters have allowed the development of fundamental concepts that are universally applicable to almost every catastrophic event in which there are large numbers of casualties. Of course, any plan has to be flexible enough to allow for the variability of circumstances surrounding a given event.[4] The collapse of the World Trade Center and the damage caused by Hurricane Katrina were disasters that required considerably different focus and emphasis in terms of response, yet the same basic management principles were employed initially.

The first part of this article focuses on some of the principles of an all-hazards approach to disaster management education. The principles covered are triage and the differences between triage in an MCI and in general practice; the concept and functioning of Incident Command Structures (ICSs) and Hospital Incident Command Structures (HICSs); the role of the federal government in disaster management; and some barriers to effective response in MCIs.

Because of the increase in geopolitical acts of terrorism, part II of this article (to be published in the August 2007 issue of the *Journal of the American Academy of Orthopaedic Surgeons*) provides a broad overview of what surgeons need to understand about the pathophysiology and injury patterns of a variety of agents that may be used as weapons. Most medical care providers have limited training or experience in disaster management. Because they would confront the many casualties with bodily injury and surgical problems, surgeons in particular must become better educated in disaster management.[5]

Triage and Evacuation

Triage is the prioritizing of patients according to injury severity and the need for immediate care. It is an essential concept to understand for the management of mass casualties.

In most disasters, the severely injured or afflicted die immediately, and the majority of survivors are not critically injured or in need of immediate care. The challenge of triage in this setting is to identify that small minority of critically injured casualties who are salvageable in the face of limited resources. This must be done rapidly and requires an entirely different approach to evaluation and care than is performed in routine medical or surgical practice. In many ways, it will run counter to training and ethical values.

American health care providers seldom practice true triage in the everyday management of trauma and surgery because virtually all injured patients are brought to hospitals where extensive time and resources are applied to the care of every individual. However, in mass casualty situations in which the number of injured overwhelms existing medical resources, triage and triage accuracy become increasingly important. The goal of treatment in this setting must change from the greatest good for each individual to *the greatest good for the greatest number*. The population as a whole, rather than the individual, must be the focus of management.[2]

Triage is effective only to the extent that the triage officers have an understanding of the injuries (ie, bodily, biologic, chemical, radiation) as well as training in the principles of mass casualty management in the face of limited resources. Who should serve as a triage officer in any mass casualty event is not as important as the need for this person to have knowledge of triage principles. This knowledge can have been gained through prior disaster experience (eg, combat triage officer; civilian emergency department director in a community with terrorist activity, such as Belfast in the 1980s or Tel Aviv today). Knowledge of triage principles might also have been gained through simulated moulage exercises using volunteers; such exercises provide the flavor, at least, of a triage situation. Surgeons, emergency medicine physicians, nurses,

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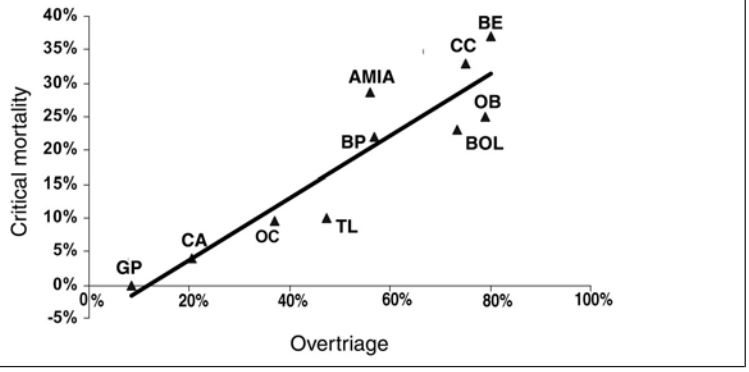
Figure 1



Graphic relation of the overtriage rate to the critical mortality rate in 10 major terrorist bombing incidents. Linear correlation coefficient (r) = 0.92. AMIA = Buenos Aires, BE = Beirut, Bol = Bologna, BP = Birmingham pubs, CA = Craigavon, CC = Cu Chi, GP = Guildford pubs, OB = Old Bailey, OC = Oklahoma City, TL = Tower of London. (Reprinted with permission from Frykberg ER: Medical management of disasters and mass casualties from terrorist bombings: How can we cope? *J Trauma* 2002;53:201-212.)

prehospital personnel, and many other acute care providers potentially can learn the skill sets required for such a role. Alternatively, in the circumstance of a purely chemical, biologic, or nuclear event, triage leadership might be given to a person knowledgeable in the area, such as a hospital radiation safety officer.

There are four widely accepted triage categories for casualties: (1) immediate, or the most severely injured who require urgent, life-saving treatment; (2) delayed, or those who are not in immediate need of treatment, including the walking wounded; (3) expectant, or those whose extensive injuries would require time and significant resource utilization and whose elevated care requirements would jeopardize the lives of many more salvageable casualties; and (4) dead. It is the expectant category that best illustrates the change in mindset necessary for the proper triage and maximal salvage in a mass casualty situation. These victims may be denied care in the interest of applying limited resources to the more salvageable casualties, thus saving the greatest number of lives. This mindset runs counter to the usual emergency care paradigm, in which the most severely injured survivors would be triaged early for immediate care.

What exactly should constitute an expectant injury will differ with each event and should be determined early in the course of a disaster response, according to the casualty load and available resources. Certainly, once casualty influx has ceased, expectant casualties can then be reassessed in light of remaining resources and possibly cared for.[6,7]

The accuracy of triage has a major effect on casualty outcome. Undertriage is the assignment to a delayed category of critically injured casualties who need immediate care. Undertriage leads to unnecessary deaths. It can be avoided by the proper training of triage officers to recognize life-threatening problems that require urgent treatment. Overtriage is the assignment to immediate care, hospitalization, or evacuation of casualties who are not critically injured, thus potentially displacing critically injured victims from necessary immediate care.

In the everyday practice of trauma care, with the abundant availability of resources, overtriage is generally accepted as an economic, administrative, and logistical burden and is considered necessary to minimize undertriage. Overtriage leads to strained resources, decreased bed availability, and harder work, but it does not jeopardize patient care.[8] However, in a true mass casualty disaster, overtriage has been shown to be as life-threatening as undertriage because of the inundation by large numbers of noncritically injured patients into a system of scarce medical resources. Overtriage during such an inundation of casualties may prevent the timely detection of the small minority who need immediate care. Triage accuracy—the minimizing of both undertriage and overtriage—is thus a major prognostic factor in the medical management of all disasters and requires extensive training of triage officers.[2,5]

The medical management of a disaster and the success of triage are best assessed by looking at the critical mortality rate. The critical mortality rate is defined as the death rate among survivors with critical injuries. This is more meaningful than basing triage success on the total number of survivors, most of whom are not at risk of death. The critical mortality rate allows for better analysis of triage accuracy between different disasters. An analysis of 1,880 survivors of 10 terrorist bombing incidents treated at one institution, from which critical injuries, overtriage, and critical mortality could be derived, revealed a direct correlation of overtriage with the critical mortality rate in major bombing disasters (Figure 1).[2] This result confirms that, in order to maximize the salvage of surviving casualties, overtriage must be minimized in a mass disaster setting as much as undertriage.[2]

Evacuation in an MCI is designed to "decompress" the disaster area, to improve care for the most critical casualties, and to provide specialized care to specific casualties, such as those with burns and crush injuries.

By decompressing the disaster scene, critically ill casualties who are consuming the most resources (supplies, casualty care space, caregiver attention) are moved to relatively resource-rich areas. Evacuation of seriously injured casualties to offsite medical facilities not only improves their care but also allows increased attention to remaining casualties.[9-11]

In a natural disaster such as Hurricane Katrina, evacuation may be hampered by the destruction of roads and transportation. In the immediate aftermath of the Hurricane Katrina devastation, evacuation was compounded by the exposure of rescuers to the lawlessness that developed. With the loss of power, the incident command center at Tulane University Hospital and Clinic (TUHC) initiated helicopter evacuation of neonates and pediatric/adult patients on ventilators. Nearly 200 patients were evacuated, including dozens who had been transferred from Charity Hospital. A heart-pump patient with 500 lb of equipment and a 600-lb bariatric patient proved to be particularly challenging. Evacuation of the TUHC staff and families required additional helicopter space, but patient evacuation was the priority. After a night spent in the parking garage, the remaining 400 of 1,000 hospital staff and families were decontaminated and evacuated.[12]

The Incident Command System

The greatest challenge in any MCI is the ability to effect a rapid and coordinated response by the many individuals and agencies involved. Regardless of cause or type, large-scale incidents invariably require the involvement of groups of individuals, health-care facilities, and agencies responding from one or more geographic or governmental jurisdictions.[13] To obtain the best outcomes, it is essential to have a mechanism to evaluate, communicate, and coordinate all aspects of victims' care, from rescue and evacuation to the time of definitive care. The ICS and the HICS are organizational tools that provide this structure. These organizational structures are simple and adaptable to many types of situations, and they are capable of being expanded or contracted to meet the needs of the specific situation.

The concept and structure of the ICS has been in evolution for more than 30 years as a mechanism to integrate the disparate emergency service agencies involved in disaster response.[14-16] In 2004, the US Department of Homeland Security mandated the ICS as the organizational tool for all incidents within our national emergency response system, including those overseen by local and state agencies.[17,18] As of fiscal year 2006, all federal funding and disaster aid given to city or state will be contingent upon their compliance with and use of the ICS.[17]

The ICS is structured around several key principles. Early implementation helps reduce the time required to bring an incident under control. All responders, including medical and hospital personnel, need to adhere to the ICS structure. As noted, the overall structure is the same regardless of the nature of the disaster; the differences are in the specific expertise of the individuals assigned to key positions for a particular type of incident. For example, in a biologic incident, one of the key positions would be staffed by an individual experienced in infection control; in a nuclear event, the same role would be staffed by someone with expertise in radiation safety and exposure.

The ICS structure is modular, allowing for incident command to expand or contract according to the changing needs of a particular situation. For optimal effectiveness, each person should supervise no more than three to seven individuals. The terminology, position titles, and communication procedures are standardized within the ICS to simplify the operational interface between different agencies, avoid confusion, and shorten response times. In the ICS structure, functional requirements, not titles, determine the organizational hierarchy. The structure is built around five major management activities: command, operations, planning, logistics, and finance/administration (Figure 2).

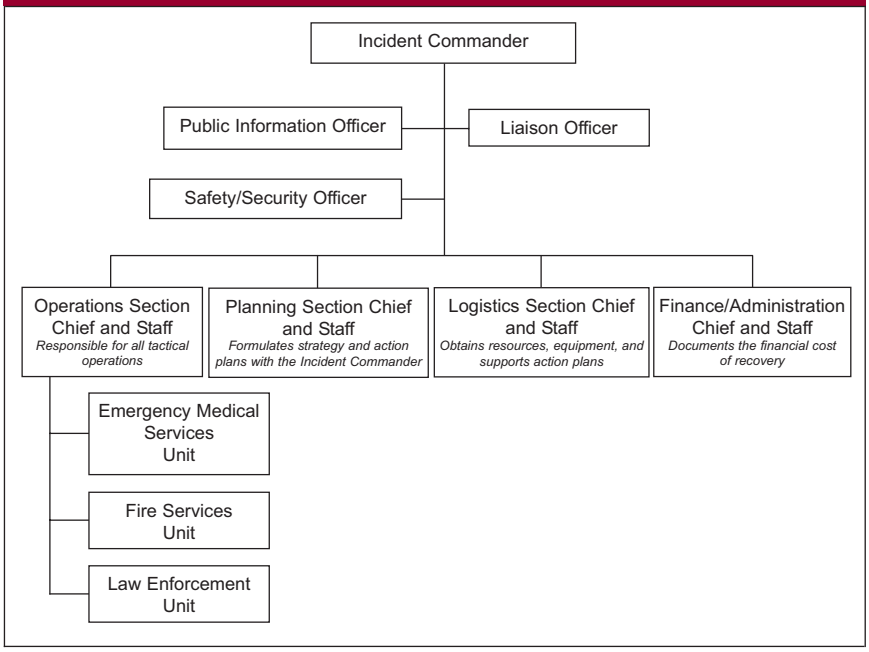
The incident commander is responsible for all aspects of the response. He or she develops the incident objectives, manages all incident operations, and delegates specific tasks and responsibilities to subordinates. Three officers report directly to the incident commander. The safety officer is responsible for assessing safety hazards at the scene of the incident and develops safeguards to protect the safety of the first responders. The public information officer serves as the point of contact for the media and the public and is responsible for developing a complete and accurate log of information regarding the incident. The liaison officer has the job of coordinating efforts with other agencies and services (Figure 2).

The remaining four activities are performed by the "general staff" and include the operations, planning, logistics, and finance/administrative responsibilities. Each of these areas is managed by a section chief who reports to the incident commander. Because of the flexibility of the system, it can be ramped up or down, depending on the size and nature of the event.

The Hospital Incident Command System

The effective use of the ICS in integrating and coordinating first responders and multijurisdictional agencies at the scene of MCIs has led to the recognition that the same principles should prove to be equally effective when applied to the response within an individual hospital. HICS (originally called the

Figure 2



The organizational structure of the Incident Command System demonstrates the relationship between the command staff, the general staff, and the section chiefs. The modular structure allows for the incident command to be expanded or contracted according to the changing needs of a disaster situation. Additional units are added as needed under each of the section chiefs.

Hospital Emergency Incident Command System, or HEICS) was developed in 1991 to implement the ICS within a hospital environment and follows the same general principles, structure, and terminology as the ICS itself.[19] The name change to HICS reflects this concept.

It is important to understand that HICS is not the actual disaster plan for the individual hospital but rather the method by which the hospital operates when an emergency is declared. The hospital's disaster plan is configured so that the ICS becomes the hospital's "standard operating procedure" whenever the plan is activated. Like the ICS, the HICS has a modular structure. Each position on its organizational chart has a specific function to perform and has clearly defined reporting channels. The five major functions outlined in the ICS are identical to those in the HICS and are critical functions in every disaster response (Figure 3).

However, under each of the four section chiefs in HICS there are units that deal with the specific requirements and constraints of the hospital setting.

The modular structure of HICS allows the hospital to activate only those elements needed to address a specific emergency. The use of a common organizational terminology facilitates communication between the hospital, first responders and other health-care facilities.

For example, according to Jim Montgomery, the chief executive officer of TUHC, the command center structure of HICS proved to be invaluable in the wake of Hurricane Katrina. Their hospital Emergency Preparedness Management Plan allowed for the chief operations officer to set up the hospital incident command center in case the National Hurricane Center declared a hurricane watch. With an upgrade to a hurricane warning, the command center took over complete control of TUHC operations, cancelled elective surgery, discharged patients, and developed staffing plans. Over the extended time period, the chief executive officer and chief operations officer rotated in the capacity of incident commander. The TUHC emergency plan anticipated structural damage as well as public utility and communication outages and provided for contingencies such as emergency generators and back-up communication systems.[12]

During Hurricane Katrina, the TUHC Incident Command Center was divided into two functions—administrative and clinical care centers—that were located in separate buildings. There was portable generator power sufficient for only one of these centers (thereby avoiding redundancy). The hospital's digital phone network went down, but analog, hard-wired phones allowed for incoming calls. Only sporadic outgoing calls could be made via mobile phones and calling cards on pay phones. Communication between the two centers and the roof of the parking garage (important for helicopter evacuation) was by two-way radio.[12]

Role of the Government in Disaster Response

Because one cannot be sure what the next disaster may entail, an all-hazards approach is a key principle of disaster preparedness. In an all-hazards approach, flexibility is the rule in disaster preparation and management.[20] Disaster response training should adapt to the unique aspects of all potential disaster events and MCIs. By definition, all disasters, regardless of etiology, exceed the ability of the local community to cope with the event and require specialized resources from outside the disaster area.

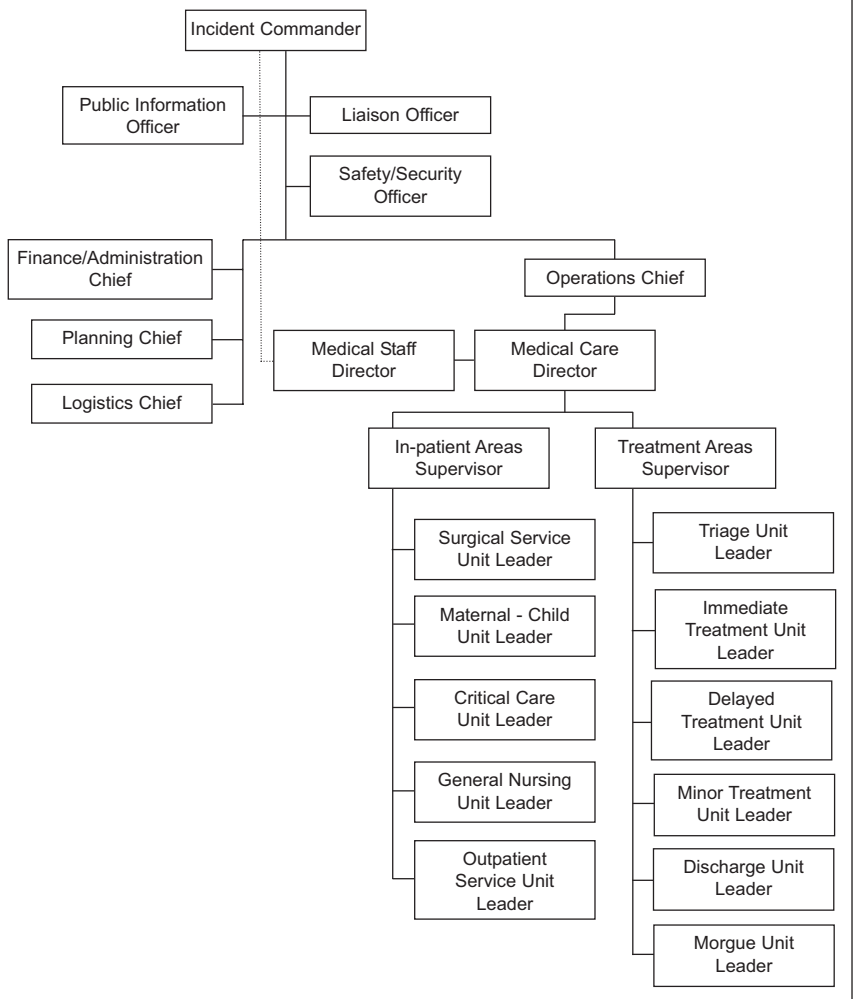
The US federal government, under the National Response Plan, has the responsibility to respond to catastrophic events that exceed state re-

sources during all four phases of disaster response: preparedness, response, recovery, and mitigation.[20] The federal government recognizes that planning and preparation require accurate assessment to properly evaluate emergencies and to analyze situations as they evolve. Breakdowns in communication hinder the ability to respond effectively and efficiently to disasters.

At the time of the World Trade Center attacks on September 11, 2001, the emergency command center for the city of New York was located in the World Trade Center. All effective communication was temporarily disrupted, leading to significant lack of coordination between responding organizations, both medical and nonmedical. Cell phones and satellite phones were nonfunctional in the first hours of the response. The same sort of situation limited the effectiveness of the disaster response during Hurricane Katrina. Many of the communication networks had underground equipment that was rendered nonfunctional in the first days of the disaster. No effective redundancy of communication facilities was present in the disaster plans at any level, markedly limiting the effectiveness of the medical response.

External communications are only one factor in an effective medical response. Lack of an effective ICS at the national, state, and local levels during Hurricane Katrina led to delays in response, inappropriate responses, and redundancy of medical efforts.

Figure 3



The organizational structure of the Hospital Incident Command System (HICS) follows the same basic structure and terminology as the Incident Command System (ICS). HICS varies from the ICS in that the "units" under the four section chiefs were created for the specific needs of the hospital setting.

Phase 1: Disaster Preparedness

Preparedness activities consist of making a community aware of the potential for a disaster (eg, the presence of an aging dam or nuclear power plant) as well as the need to train personnel, purchase equipment, support response activities, marshal resources, engage in interagency planning, and conduct a full spectrum of community preparedness exercises.[9]

Phase 2: Disaster Response

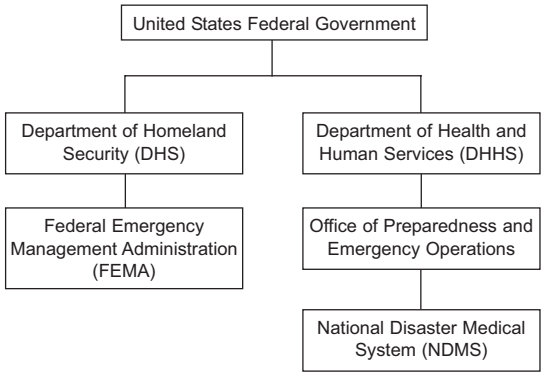
Like the Advanced Trauma Life Support ABCs of trauma care, disaster medical response includes basic elements that are similar in all disasters. Medical concerns related to MCIs include four elements: search and rescue, triage and initial stabilization, definitive medical care, and medical evacuation. The difference is the degree to which these responses are used in a specific disaster and the degree to which outside assistance is needed to perform the ABCs of disaster care. Rapid assessment by experienced personnel and utilization of the ICS should allow responders to modulate the deployment of these four elements as a disaster evolves.[9]

Table 1

Emergency Support Function No. 8 Menu of Functional Areas[20]

Assessment of health and medical needs
Health surveillance
Medical care personnel
Health and medical equipment and supplies
Patient evacuation
In-hospital care
Food/drug/medical device safety
Worker health/safety
Radiologic/chemical/biologic hazards consultation
Mental health care
Public health information
Vector control
Potable water, and wastewater/solid waste disposal
Victim identification/mortuary services
Veterinary services

Figure 4



As of January 1, 2007, the National Disaster Medical System (NDMS) is under the newly created Office of Preparedness and Emergency Operations within the Department of Health and Human Services (DHHS).

Disaster response also deals with public health concerns related to MCIs. They include water, food, shelter, sanitation, safety and security, transportation, communication, disease surveillance, and endemic and epidemic diseases.

In the event of a disaster, the National Response Plan provides a menu of Emergency Support Functions (ESFs) most likely to be needed during an incident.[20] ESF no. 8, Public Health and Medical Services, provides federal assistance to supplement state and local efforts in responding to public health and medical care needs following a disaster. When state and local assets are overwhelmed and federal assistance has been requested, ESF no. 8 offers an assessment of 15 important health-related areas (Table 1). ESF no. 8 falls under the provenance of the Department of Health and Human Services, with several reporting agencies, such as the Centers for Disease Control and Prevention. Coordinating agencies include the Department of Homeland Security, Department of Agriculture, Department of Defense, and other agencies.[20]

The National Disaster Medical System, which is part of ESF no. 8, provides medical response teams, equipment, and supplies to a disaster area as well as medical care to victims both in transit and within participating hospitals that are outside the affected area. The National Disaster Medical System can mobilize and deploy Disaster Medical Assistance Teams as well as provide air medical evacuation and definitive care. It also incorporates several specialty Disaster Medical Assistance Teams (eg, burns, pediatrics) as well as three medical teams that can deploy anywhere in the world.[21]

International medical surgical response teams are managed in conjunction with the US Department of State and are currently based in Boston, Miami, and Seattle. These teams have full modular field hospital units that are capable of providing medical, surgical and intensive care services in austere environments. Their development was a direct response to threats to Americans abroad following the US embassy bombings in 1998 in Tanzania and Kenya.

Effective January 1, 2007, the National Disaster Medical System was moved from the Department of Homeland Security to the Department of Health and Human Services under the newly created Office of Preparedness and Emergency Operations. This was done with the intention to provide better coordination of medical and public health response capacities. The Federal Emergency Management Administration will continue to be under the Department of Homeland Security for nonmedical responses (Figure 4).

Phase 3: Disaster Recovery

The recovery phase is frequently underemphasized in disaster plans,

but it is crucial for the affected community. During this phase, some semblance of order is restored, public utilities are reestablished, and infrastructure begins to operate effectively. Withdrawal of emergency services and personnel from the scene and a return to normal operations usually occur simultaneously.

The reconstruction phase is marked by large-scale efforts to permanently replace damaged buildings, revitalize economies, and restore agricultural systems to their full predisaster production capacity.[9]

Phase 4: Disaster Mitigation

Disaster mitigation can occur at any time during the disaster cycle. In certain cases, some of the devastating effects of disasters can be reduced before the actual event. For example, evacuations may be orchestrated before hurricanes or floods. Early warning allows residents to seek shelter from tornadoes. Sprinkler systems in businesses and homes can reduce overall risk of total fire destruction.[9]

Response to an MCI emphasizes a consistent approach to disasters based on an understanding of their common features and the expertise required in all four phases of the disaster. The goal of the National Response Plan is to mobilize the expertise of various government agencies to meet the functional needs of the disaster, using the ICS to ensure that disaster resources are mobilized in the most efficient manner at the disaster scene, thus reducing death and disability.[20]

Barriers to an Effective Disaster Response

In any MCI, a small group of critically injured patients (typically 5% to 25% of living casualties) will be contained within the larger crowd of less severe casualties.[2] The core mission of a hospital disaster response system is to identify these critical casualties and to provide them with the requisite level of trauma care. This may require the diversion of life-saving trauma assets away from the less severely injured.[22] A key barrier is defined as an obstacle that threatens this core mission. Anticipating key barriers and preparing for them is therefore an essential part of an effective response.

Some of the most important key barriers have to do with implicit assumptions built into the plan. Early warning is one example. Whereas most disaster plans assume sufficient advance warning to deploy the hospital disaster response envelope, this rarely happens. In a daytime urban bombing scenario, lack of adequate warning will mean a sudden overload of already full facilities. In a nighttime MCI, it will mean an extremely thin and fragile response capability until additional trauma assets are brought in. In a scenario involving weapons of mass destruction, lack of advance warning may mean that the hospital has been breached or contaminated before the disaster plan is activated.

Another possible key barrier is the inability of the HICS to keep up with the rapid evolution of an MCI.[23] The command structure is a linear, top-down hierarchical structure; an MCI is often a chaotic, nonlinear system that outpaces the flow of information. Staff often must make crucial, on-the-spot decisions based on partial data. Because chaotic systems are extremely sensitive to initial circumstances and conditions, these local decisions may have enterprise-wide consequences. The hospital emergency plan must possess a flexible, adaptable command structure to overcome this potential barrier.

Errors and misjudgments are common in every MCI. Error-tolerant planning is a strategy for overcoming key barriers by accepting that errors are inevitable and yet seeking ways to mitigate their adverse effects. Triage errors are an excellent example. A rapid and cursory glance at an incoming casualty on the ambulance dock is not an accurate method of clinical assessment. Instead of attempting to reduce overtriage, it is possible to minimize its adverse effects either by increasing the number of service points for critical casualties (eg, improvised resuscitation bays) or by decreasing turnover times.

Furthermore, the flow of casualties between service points creates bottlenecks that become key barriers when they affect trauma care for the critically injured. These bottlenecks can be identified by analyzing past incidents (including busy weekend nights), learning lessons from disaster drills, or using discrete-event computer simulation.[24] The disaster plan then can be modified to reformat problematic facilities, either by increasing their capacity or by instituting guidelines for more restricted use during an MCI.

The most crucial key barrier to an effective response to a large-scale MCI is lack of institutional commitment. Despite increased awareness since 9/11, emergency preparedness in most hospitals remains the province of a select group of dedicated individuals. The major barrier we face in preparing for large-scale MCIs is this institutional culture of selective participation, not the lack of sophisticated communication systems or protective gear. Commitment in the form of education, training, and interdisciplinary communication—not technology—is the key to an effective medical response.

Summary

The role of health care providers mandates education and awareness in disaster management and mitigation. Despite the chaotic disruption that natural, accidental, or intentional acts may impose on hospitals and health care workers, a well-planned systematic approach and structured organizational response (eg, HICS) can help lessen the lethal

effects of disaster. Each surgeon should be familiar with his or her hospital's emergency management plans and the structure, roles, and functions of that hospital's incident command center.

The critical mortality of victims can be significantly reduced by applying the paradigm of disaster triage (ie, the greatest good for the greatest number) and through evacuation and decompression of the disaster scene. Volunteerism through federal and international medical surgical response teams provides invaluable service in austere situations. Effective and accountable federal planning, real-time disaster assessment, and a quick response to catastrophic incidents can ensure critical lifesaving assistance.

Although natural disasters constitute our major vulnerabilities and a disproportionate number of major hazardous incidents, disruption caused by intentional acts of terrorism may pose unfamiliar demands on hospitals and health care workers and potentially present unforeseeable consequences. The keys to success in minimizing mortality are preparation, planning, and practice.

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