

Disaster

Pediatric Intensive Care Unit/ Emergency Division

A disaster occurs somewhere in the world almost daily; however, to most people, disasters of the type discussed in this article are unusual events. A recent group of disasters, starting with the September 11th terrorist attacks and continuing through the tsunami affecting countries throughout the Indian Ocean, the South Asia earthquake in Pakistan, and the 2005 and 2008 Gulf Coast hurricanes have focused people's attention upon this topic.

Table 1. US Disasters With Greater Than 1000 Casualties*

Year	Event	Deaths
1865	Steamship explosion	1547
1875	Forest fire, Wisconsin	1182
1889	Flood, Pennsylvania	>2000
1900	Hurricane, Texas	8000
1904	Steamship fire	1021
1906	San Francisco earthquake	>3000
1928	Hurricane, Florida	2000
1941	Pearl Harbor Attack	2403
2001	September 11 Attack	2819
2005	Hurricane Katrina	>1300**

Natural versus technological disasters

Disasters are classified in a variety of ways. A common system divides incidents into natural and technological (human-made) disasters. For planning purposes, this distinction provides little conceptual help as there are frequent crossovers. For example, artificial structures may collapse as the result of hurricanes or earthquakes. During Hurricane Katrina, emergency personnel had to contend with fires while rescuing people from flooded areas.

Certain generalizations, however, may be made about natural disasters. Tornadoes may be quite lethal but are generally short-lived. Hurricanes cut a wider swath than tornadoes, tend to last longer, and have more long-term recovery effects. Tornadoes, hurricanes, and floods tend to occur in certain geographic locations. Volcanoes also may be quite lethal but have become more predictable in recent years. Until recently, the most devastating natural phenomena, with regard to numbers of fatalities, were thought to be earthquakes. However, the December 2004 tsunami affecting countries throughout the Indian Ocean, with an official death toll of 224,228 people, ranks as one of the most lethal disasters in recorded history.

War and terrorism

Other incidents with potential for mass casualties and disaster include war and terrorism. Since the 9/11 attacks on the World Trade Center in New York City, terrorism has become a major focus of disaster response and preparedness. Although the world has yet to experience a terrorist-related nuclear disaster, the raw materials and technology exist to develop nuclear devices as small portable units such as "dirty-bombs." No geographical location is immune from the devastating effects of terrorism. These activities have become more frequent and lethal in recent years with no forewarning, as evidenced by the 9/11 attacks, the Madrid and London bombings, and the more distant, but still tragic, Sarin nerve agent attack on the Tokyo subway system.

Classifying disasters

Disasters are often classified by the resultant anticipated necessary response.

- A Level I disaster is one in which local emergency response personnel and organizations are able to contain and deal effectively with the disaster and its aftermath.
- A Level II disaster requires regional efforts and mutual aid from surrounding communities.
- A Level III disaster is of such a magnitude that local and regional assets are overwhelmed, requiring statewide or federal assistance.

Disaster preparation

Various methods have been developed to assist planners in disaster preparation. One such method is a modification of the Injury Severity Score. It is based on cause and effect, the area involved, the number of casualties, and other parameters. The potential injury creating event (PICE) system is designed to identify common aspects of a disaster and of response capabilities. Such systems are especially valuable tools in planning for disaster mitigation.

The PICE system uses 4 modifiers to describe a particular disaster (see Table 2). The first modifier describes the potential for additional casualties. The second identifies the degree to which local resources are disrupted. The third modifier identifies the geographic boundaries of involvement. The final modifier, crisis staging, indicates the likelihood of needing outside assistance to augment or replace local resources. It is important to note that in the PICE methodology, identical disasters may have differing descriptors depending on the location of the event and the availability of resources.

Table 2. Potential Injury-Creating Event Algorithm

A	B	C	Stage
Stable	Static	Local	0
Dynamic	Disruptive	Regional	I
	Paralytic	National	II
		International	III

Definitions and Terminology

Disaster medicine is difficult to conceptualize. It can be broadly defined.

The World Health Organization defines a disaster as a "sudden ecological phenomenon of sufficient magnitude to require external assistance." The American College of Emergency Physicians (ACEP) states that a disaster has occurred "when the destructive effects of natural or man-made forces overwhelm the ability of a given area or community to meet the demand for health care." Other definitions exist, but the common denominator calls for a disruption of such magnitude that the organization, infrastructure, and resources of a community are unable to return to normal operations following the event without outside assistance.

To further clarify the contrast between normal emergencies and disasters, ACEP states, "emergency medical services routinely direct maximal resources to a small number of individuals, while disaster medical services are designed to direct limited resources to the greatest number of individuals."

Phases of Disaster Response

A disaster cycle has 4 phases, and all responses must pass through each: (1) mitigation, (2) planning, (3) response, and (4) recovery. Pitfalls during transitions can occur throughout the phases. Generalized awareness, proper planning, and contingencies may reduce the overall effect of any specific inadequacy in response.

Mitigation

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.

Planning

Disaster planning is discussed more thoroughly in External and Internal Planning. It cannot be stressed enough, however, that a disaster plan is not synonymous with disaster planning. Many communities have detailed, "paper" plans, which, when tested, are found to be either based on faulty assumptions or to be totally unworkable in the context of the initial response.

Response

A number of events occur during initial response to a disaster. If there is forewarning, certain aspects of the response may take place even before the event. Unfortunately, significant forewarning is rare.

Activation

Notification and initial response

During this phase, organizations involved in disaster response and the potentially affected populations are notified. In the event that the disaster is anticipated, this phase takes place even before the disaster. Many locations in hurricane areas require more than 24 hours for full evacuation.

Organization of command and scene assessment

Once the activation phase has begun, the prearranged command and staff structure (for details, see Incident Command System below) for responding to the disaster should be arranged and initial communications nets established. This is one of the most crucial steps to take once the disaster occurs. Historically, valuable time may be lost during a disaster response while the central system coordinating the response effort is being prepared. During this phase, initial reports leading to overall scene assessment begin to arrive. For static disasters, required response assets may need to be determined. Often, the only initially known fact is that the disaster is an ongoing process. However, even this fact is important in determining whether outside assistance is needed, leading to timely activation of those resources.

Implementation

Search and rescue

Depending on the structure and function of the incident command system (ICS), search and rescue may fall under the direction of fire, emergency medical service (EMS), or police (security) forces. In contained, geographically localized incidents, the search and rescue effort is fairly straightforward. In larger disasters, especially ones that are ongoing or may involve terrorist activities, a cooperative approach is necessary and the very act of search and rescue must be highly organized to ensure adequate and complete coverage of all areas.

Extrication, triage, stabilization, and transport

Extrication has evolved into a fire services function in most of the country. In addition to specialized technical and trench rescue teams, fire services have more experience with building collapse and secondary hazards (eg, floods, fires) than other organizations.

The concept of triage involves providing the most help for as many as possible. A complete description of triage is beyond the scope of this review. Medical personnel are accustomed to providing extensive, definitive care to every patient. When confronted by numerous patients simultaneously in a disaster situation, it is easy to become overwhelmed, even for an experienced disaster worker. Triage must occur at multiple levels, and patients must be reassessed during every step of the process.

Transport must be both organized and orchestrated to equitably distribute victims to capable receiving facilities. During recent civilian disasters and even in Operation Desert Storm, the majority of critically injured individuals were taken to only one or two receiving facilities, which were almost overwhelmed. This occurred at a time when other facilities sat dormant awaiting patients.

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. Scene withdrawal and a return to normal operations usually occur simultaneously. Treatment of the responders is also vitally important during this phase for critical incident stress debriefing and other support services that have evolved for this purpose.

Debriefing

Valuable lessons may be learned during debriefing. It is of utmost importance to obtain as much information as possible from all parties involved in the disaster response effort. Without full disclosure, similar weak responses will impede future efforts.

External and Internal Planning

External planning

Disaster planning should to the extent possible incorporate formal disaster research findings. Disaster plans sometimes rely on faulty assumptions that do not prove true in actual disasters. For example, planners may logically assume that the sickest patients will be transported first during a disaster, when, in reality, this may not happen in many instances.

A disaster plan encompassing both local and regional areas must focus on 3 possible scenarios:

1. The disaster occurs within the region and is confined and controlled with existing resources.
2. The disaster occurs in a neighboring region, and regional assets are requested through mutual aid agreements.
3. The disaster area is the region and requires state or federal assistance for an effective response.

Incident command system

After a series of fires in California in the 1970s, the Fire Suppression Services developed the ICS concept to organize an effective response to major disasters. The ICS structure includes 5 functional units: command, operations, logistics, planning, and finance (see Media file 1). Most disaster plans include similar organizational structures that are often modified depending on normal operations of the various agencies.

In developing a disaster plan, leaders should remember that it is impossible to plan for all contingencies; therefore, plans must be relatively general and expandable. Most disasters that can be contained using local or regional resources have fewer than 100 fatalities and fewer than 500 major casualties. If plans are developed for larger-scale disasters, the plan should focus on the first 48 hours of the disaster until state and federal assistance teams can arrive and to address high initial fatality rates during the first 24 hours.

Rehearsal

All phases of the disaster response must be addressed in a disaster plan. Functional job descriptions and responsibilities of all agencies and organizations involved should be delineated clearly. More importantly, these plans should be exercised and rehearsed. The ideal exercise includes participation by all parties involved. Since these exercises, by their very nature, disrupt normal operations and are costly in personnel and material utilization, disaster agencies frequently conduct a proxy exercise on the "tabletop." This is a simulation of an emergency situation for training and testing plans and procedures that does not involve movement of response resources. Tabletop exercises are good training tools because they allow people in leadership positions to work through major problems without the cost of running vehicles, using staff and volunteer time, or using supplies. They can quickly highlight areas of weakness where additional support may be needed.

Organization

As part of the Federal Response Plan, the National Disaster Medical System was developed in the 1980s by the Department of Defense, the Veteran's Administration, the Federal Emergency Management Agency, and the Department of Health and Human Services. The Federal Response Plan calls for the development and response of up to 12 functional units to assist, but not direct, the disaster response initiative on declaration of a state of emergency by a territory or state government.

Approximately 1000 stateside beds were identified in preparation for Desert Storm, although no simulation exercise was performed, leading to criticism from the Government Accounting Agency. Disaster medical assistance teams (DMATs) are groups composed of volunteer physicians, nurses, EMS personnel, and others who are transported to disaster sites to participate in the triage, stabilization, transport, and treatment of patients. As examples of use of these teams, DMATs responded to the Oklahoma City Federal Building bombing, Hurricane Katrina, and have prestaged at certain critical events, such as the Atlanta Olympic Games.

Internal planning

Hospital disaster planners must take into account the scenarios previously described, including the possibility that the disaster may involve the hospital. For such rare events, aspects of hospital involvement such as mass decontamination, multiple triage and staging areas within the confines of the hospital, recall of critical personnel, and provisioning of adequate supplies and resupply must be anticipated. The Joint Commission (formerly Joint Commission on Accreditation of Hospitals [JCAHO]) requires hospitals to exercise disaster plans periodically and to form disaster committees. These committees should comprise key departments within the hospital, including administration, nursing services, security, communications, laboratory, physician services (including, but not limited to, Emergency Medicine, General Surgery, and Radiology), medical records, and maintenance/engineering.

The hospital disaster plan should include protocols and policies that meet the following needs:

- Recognition and notification
- Assessment of hospital capabilities
- Personnel recall
- Establishment of a facility control center
- Maintenance of accurate records
- Public relations

New, more stringent requirements for health care organizations were approved by the Joint Commission in 2000 and went into effect in 2001. Probably most significant are the requirements to integrate hospital disaster planning into community plans, to ensure that disaster programs address all phases of the disaster cycle, and to have the capability to evacuate the entire hospital staff and patients and relocate and operate from an independent facility. Discussions are continuing with the Joint Commission to further strengthen requirements concerning decontamination, polices, and training in response to terrorist activities involving chemical, biological, radiological, nuclear, and explosive agents.

Summary

Disaster planning is a regional effort. Every jurisdiction should plan for MCIs and disasters. All plans must be simple and based on normal daily operations of the various components involved in the disaster plan. Personnel potentially involved must be familiar with the disaster plan. It should be exercised frequently, even if only by tabletop exercises. Contingency plans for mutual assistance and state or federal response also must be considered and reviewed.

Thank you