

CHAPTER 7

Occupationally Based Disaster Medicine

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Introduction

Occupational medicine interfaces with emergency medicine during disasters in several important ways. In the event of a disaster, the occupations or specific job duties reported by the first victims presenting to the emergency department (ED) may provide the first clues to the covert release of a chemical, biological, or radiological agent. Furthermore, occupational exposures may complicate acute care and long-term follow-up. Disaster medicine requires the addition of the population perspective of occupational and environmental medicine to the patient-centered model of emergency medicine. ED staff are at risk for exposure to a variety of contaminants during disasters, and the safety and health of these personnel are the clear responsibility of the hospital's occupational health department. For example, occupational health is responsible for the medical evaluation of ED personnel who may use respiratory protection during a disaster. Victims may include first responders and emergency medical services (EMS) personnel, and occupational medicine has unique insights into the special hazards faced by these workers [1]. Hazard identification, risk assessment, and risk communication—to patients, staff, and the media—are specialized competencies of occupational health.

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Disaster planning must include an assessment of the occupational risks of ED personnel and of the physical infrastructure of the ED; this responsibility should be shared with occupational medicine. The development of survey tools and medical surveillance measures for ED workers involved in a disaster [2] is the responsibility of the occupational health department, and one of the advantages of the involvement of occupational medicine in these efforts is its cost-effectiveness: even if a disaster does not occur, the surveillance tools developed by the occupational health department will find use in everyday ED activities [3].

Ten principles of occupationally based disaster medicine

1 Know the differences between disasters and typical emergency care

A disaster can be considered "an event that exceeds (or might exceed) the resources for patient care at that time, for a community, a hospital, or both" [4]. It is crucial to understand how disasters differ qualitatively, not just quantitatively, from everyday emergencies in the ED. ED providers normally do not worry about extraordinary risks to their own health given their adherence to standard precautions or, less frequently, to contact, droplet, or airborne precautions. Contaminated patients from an unconventional disaster, however, may expose ED workers via inhalation or direct contact and may contaminate the ED itself. Providers must prevent or minimize their own exposure and exposures to other hospital staff. Some staff may be unwilling to confront the additional risks to their own safety

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and health; conversely, the ED may have to handle large numbers of volunteers. Disasters typically result in an "upside-down" triage pattern, in which less critically affected patients arrive first on foot or by private transport; if EDs practice "business as usual" and become overwhelmed by the management of these patients, the later arrival by ambulance of even more critically affected patients may lead to chaos [5]. Disasters are characterized by the markedly increased proportion of total cases represented by worried individuals who present for medical evaluation because of their suspicion of being exposed, especially when the threat is unknown or invisible, such as biological agents or radiation.

Even more serious is the shift in mindset involved when it is necessary to triage some patients as expectant who in a typical emergency would be seen promptly and afforded all of the resources needed for resuscitation. In a disaster, the misallocation of limited resources may result in the survival of a few patients at the cost of many more lives. Some kinds of disasters present as clusters of unusual cases that are misdiagnosed at first; the recognition of the disaster may depend largely on prior training of ED staff and their ability to recognize rare and unfamiliar syndromes. In a disaster, risk communication to patients and staff alike is paramount. The physical and psychological stresses associated with disasters predispose staff to fatigue, medical errors, and acute stress disorders. Another unique characteristic of disasters is the importance of identifying and registering both patients and staff for medical surveillance for long-term medical and psychological effects.

The most important difference between disaster medicine and typical emergency medicine, however, may well be the organizational challenges, which require, over and above the usual managerial skills, decisive leadership, and regular training and drills. Failure to recognize and address these differences before a disaster occurs will almost certainly result in significantly increased morbidity and mortality among victims and staff.

2 Know and become involved in your organizational response to disasters

A common misperception is that the most crucial responsibility of ED staff in a disaster is the continuing

provision of one-on-one patient care according to the standard daily operations of the ED, simply at a more frenetic pace. A related mistake is to assume that planning is predominantly an administrative responsibility and that ED staff should be only minimally involved in the organizational response to a disaster. In fact, when hospital resources are outstripped by a disaster, the most important action is the allocation of those limited resources in order to save the lives of as many people as can possibly be saved while avoiding misallocation of resources to patients who are either not severely affected enough to warrant immediate attention or who are so seriously affected that the allocation of resources to their care would cause the death of several more patients who otherwise could survive [6]. Direct patient care is still the end, but the effectiveness of the organizational response is the most important factor in whether appropriate patient care can be delivered.

Every ED employee thus needs at least an awareness course in disaster response. This course must address the four sequential phases (prevention, preparedness, response, and recovery) [7] and the nonsequential phase (mitigation, which applies throughout all the other phases) of disasters and must cover the National Incident Medical System (NIMS) [8, 9], the National Response Framework (NRF) [10], and the Incident Command System (ICS) [11], despite continuing problems with the implementation of these programs [12, 13]. It is critical that each ED staff member knows (and practices) the specific roles and responsibilities that he or she will undertake after the activation of the hospital emergency response system. Senior ED staff and appropriate occupational health staff need additional training and should be actively involved in hospital planning for disasters.

3 Know your own risks

Disaster response plans are based on an "all-hazard" approach, which provides a template that can then be modified as the specific disaster unfolds. The risk of high-impact but low-probability disasters, although probably greater in urban than in rural settings, is difficult to quantify. The risks of natural disasters and of many man-made disasters, however, can and must be quantified based on the

location of the hospital (in a disaster, most casualties go to the nearest hospital [14]) with respect to fault lines, storm patterns, chemical plants, nuclear facilities, transport hubs, terrorist targets of significance (large hospitals by themselves are such targets), and specific vulnerabilities of the hospital in terms of infrastructure (air circulation patterns in and out of the ED, wall strength, traffic patterns) and resources. Such a specific risk assessment is required by The Joint Commission and is termed a hazard vulnerability assessment (HVA) [15–17]. Knowing the specific vulnerabilities of a hospital is an indispensable tool in preparing for and responding to a disaster. The collaboration of emergency medicine and occupational health personnel is essential in developing the HVA.

4 Prepare to acquire and allocate “stuff, staff, and space”

Because the definition of a disaster emphasizes the lack of deliverable resources, plans must address (1) the distribution of the available resources—as Geiling wrote, “stuff, staff, and space” [7]—and (2) the rapid acquisition of additional resources as needed. No ED can be expected to provide all of the medication, equipment, personnel, and space needed for every conceivable disaster, but the HVA can guide the requisitioning of specific medication and equipment judged necessary for the most likely disasters at that specific ED as well as the planning for surge capacity involving additional beds in and out of the hospital and procedures for notifying and calling in additional staff. Additional resources may be available from state, regional, or federal sources (such as the Strategic National Stockpile) [18], but in general each ED should prepare to be self-sufficient for 24–48 h [14]. Planning is paramount, because in many disasters the lack of available resources results not from insufficient resources either already onsite or delivered but from organizational problems in the identification and distribution of resources already available [19]. Personnel are the most valuable resource, but personnel not specifically trained to work together in teams for disasters may do more harm than good. In particular, evidence suggests that ED staff who are on duty when a disaster occurs will tend to become overworked and both physically and mentally stressed,

resulting in decrements of care, and that better results may result from the assignment of a previously trained and drilled disaster treatment team that can take over in any emergency [20]. In any case, occupational medicine resources should be used to monitor the safety, health, and performance of ED staff involved in disaster response.

5 Establish and test redundant forms of communication

Although The Joint Commission requires a reliable communication system for disasters [21], breakdown of communication is one of the most frequently reported and one of the most serious problems in disaster response. The problem encompasses communication within the ED, with other areas of the hospital, and outside the hospital and can take many forms, from power failures (and attendant communication losses) outside the hospital, overloading of telephone networks and Internet sites, and problems with two-way radios. Three important principles emerge. The first is to establish multiple backup systems [14, 22] and to test them at specified intervals to make sure that more than one backup system is always available. The second is to establish and test recall-and-notification rosters with at least two backups for each staff member who has a role in a disaster response. The third and most crucial is to realize that in disasters, organizations do not contact one another; people do. The importance of forging and maintaining professional contacts among individuals has been borne out multiple times in disaster response.

6 Be prepared to practice disaster triage

As previously mentioned, triage in a disaster requires a paradigm shift from triage in ordinary ED settings [6]. Disaster response sometimes requires a change from the virtue-based ethics of trying to save every patient to a utilitarian model of providing the best care for the most victims at the expense of those who would demand resources that otherwise could save many more salvageable patients. The ethical issues associated with this shift are important and have been discussed in several sources [23, 24], including a directive from the U.S. Department of Health and Human Services [25]. Several systems

of rapid disaster triage exist [26–28]; the greatest difference between these systems and the usual systems of triage is the emphasis on an expectant, or unsalvageable, category of patients who will receive palliative care but not definitive treatment unless subsequent retriaging changes their category. Although intended primarily for intensivists, the discussion by Mahoney et al. [22] of considerations in mass casualty triage is pertinent to EDs as well.

7 Know how disaster decontamination and personal protective equipment work

Another common misconception is that in a disaster involving risks of chemical, biological, or radiological contamination, decontamination will have been accomplished before patients arrive at the hospital. At the other end of the spectrum, many emergency physicians envision themselves garbed in self-contained breathing apparatus as they try to decontaminate patients. In fact, many patients, especially those who come to the ED on their own, will not have been decontaminated, but decontamination will not normally require the highest level of personal protective equipment. It is important for emergency physicians to distinguish between first responders (those who respond to the disaster scene) and first receivers (those in EDs) and to become acquainted with *Occupational Safety and Health Administration (OSHA) Best Practices for Hospital-Based First Receivers of Victims from Mass Casualty Incidents Involving the Release of Hazardous Substances* [29]. This document defines the hospital decontamination zone and the hospital postdecontamination zone (which should begin before or at the entrance to the ED) and lists the requirements (including an HVA) and assumptions involved in designating these zones and the personal protective equipment recommended for each zone. Emergency physicians may or may not be part of the ED teams designated to perform patient decontamination in the hospital decontamination zone, but they will supervise those teams and are responsible, along with occupational health personnel, for the safety and health of the teams. In addition, emergency physicians must understand the different priorities for decontamination. In general, patients with exposure to liquid chemical agents or to sulfur-mustard vapor must be decontaminated as soon as possible because

of the fast penetration of these agents in these forms. Patients with skin exposure to other vapors, to most toxins, to most biological agents, or to most forms of radiation do not require the immediate attention that the first group does, and decontamination can be delayed. It is also important to realize that even late decontamination, although perhaps too late to avoid local skin damage, may still save the life of the liquid-contaminated patient by preventing continued absorption of the liquid agent into the body.

8 Plan to address acute and long-term effects on both patients and staff

Acute care of disaster victims must be dictated by the mechanisms of injury or disease the victims have undergone and must be informed by an appreciation of the possible agents and their presentations. Because the most common presentation in most storms and terrorist events is trauma (explosives are still the most common method employed by terrorists to produce mass casualties) [6], emergency physicians must be familiar with the pathophysiology, recognition, and management of blast injuries [30], crush injuries [31], and burns [32]. Disaster-related stress is so common in both patients and staff that ED workers should also know how to recognize, triage, and manage this kind of trauma [33, 34]. Treatment algorithms or condition summaries for important but infrequently seen conditions such as blast and crush injuries, chemical exposures, and unusual infections can be posted in the ED as reminders of previous training (not as substitutes for such training) [35]. Occupational health resources are crucial in the response phase of a disaster not only for exposure assessment of current hazards in the ED but also for biological monitoring of clinically inapparent disease and health effects monitoring (medical monitoring) of overt disease in victims, first responders, and first receivers and for the early development of tools to identify and follow disaster participants for long-term effects.

9 Become familiar with available resources now and use them now

The Joint Commission requires disaster training for hospitals, and a variety of disaster medicine training resources are available in the form of live courses, online courses, and online references. One problem with the large number of references is the challenge

of finding the most relevant. The Centers for Disease Control and Prevention (CDC) is undertaking several disaster-related projects, including PEHI-NET (a secure, Internet-based disaster communication network that is an outgrowth of the CDC Pacific Emergency Health Initiative) and the Automated Disaster and Emergency Planning Tool, or ADEPT [36]. The National Library of Medicine has created a useful set of disaster medicine resources [37], which include the Wireless Information System for Emergency Responders (WISER) and the Radiation Event Medical Management (REMM) System; these tools are available both online and also for download, so that interruption of Internet service need not prevent ED staff from using them. A related module (CHEMM, for Chemical Hazard Event Medical Management) is currently under development by the author and others. Other resources are available for use during the response phase of a disaster [38, 39], but these assets are best used by those who have previously familiarized themselves with the modules rather than by those who try to use them for the first time in a stressful disaster situation.

10 Practice realistically

The Joint Commission also mandates regular hospital disaster drills [19], but hospital drills, when they occur, are often rushed and artificial. Exercises must be as realistic as possible and must test the limits of the response from the hospital. Exercise controllers must be prepared to modify the course of the drill, even dramatically, to accommodate the observed responses from hospital participants. Disaster practices can be innovative and rewarding [40], but above all they must be conducted with sufficient frequency, realism, and performance-based evaluation, feedback, and review to enable ED staff to respond to a disaster with the same reflexes and confidence with which they approach the identification and management of a cardiac arrest.

Conclusions

Although disasters can differ qualitatively as well as quantitatively from normal operations in an ED, attention to the occupational health issues that attend every disaster and a focus on the ten cardinal

principles of occupationally based disaster medicine can make a decisive difference in the management of disasters in EDs.

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