Defining disaster: the emergency department perspective

JOSEPH ZIBULEWSKY, MD

Thou shalt be visited by the Lord of hosts with thunder, and with earthquakes and great noise, with storm and tempest, and the flame of devouring fire (Isaiah 29:6).

On the basis of the opening quote, Isaiah could be considered one of the first disaster epidemiologists. "Disaster" comes from the Latin word *astrum*, which means star. The ancients believed that earthquakes, volcanoes, and the like were mandated by the heavens. Even today, we do not have much control over these natural disasters, but we do have control over their effects.

The American College of Emergency Physicians defines disaster as "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." The World Health Organization defines it as "a sudden ecologic phenomenon of sufficient magnitude to require external assistance." In either case, disasters are defined by what they do to people.

Disasters are divided into 2 basic groups: natural and man-made. Among the natural disasters are earthquakes, volcanoes, hurricanes, floods, and fires. Among the man-made disasters are war, pollution, nuclear explosions, fires, hazardous materials exposures, explosions, and transportation accidents. The World Health Organization began using the term "complex humanitarian disaster" after the fall of the Soviet Union to refer to a specific type of man-made disaster: a combination of civil strife and conflict leading to a mass exodus of people and the events that follow, such as disease and destruction of property. Complex humanitarian disasters have occurred recently in Croatia, the Balkans, and Rwanda. Also possible are combined natural–man-made disasters, as would occur if an earthquake destroyed a nuclear power plant.

Usually we think of disasters as acute situations, but they can also be chronic. The famine in North Korea during the early 1990s killed an estimated 2 million people. The chronic pollution in Love Canal was created over a period of 20 or 30 years but still constituted a disaster.

Worldwide, a major disaster occurs daily, and natural disasters needing international assistance occur weekly. Over the past 20 years, 3 million deaths and $50 billion in property losses have been attributed to disasters. With more people moving into disaster-prone areas—including earthquake zones, flood plains, and coastal areas in the USA—the risk will increase in years to come.

Table. US peacetime disasters with deaths exceeding 1000

Year	Disaster	Deaths
1865	Explosion of the steamship *Sultana* in Memphis, Tennessee	1547
1871	Forest fire in Peshtigo, Wisconsin	1182
1889	Flood in Johnstown, Pennsylvania	>2200
1900	Hurricane in Galveston, Texas	>6000
1904	Fire on the steamship *General Slocum* in New York's East River	1021
1928	Hurricane in Lake Okeechobee, Florida	2000

Interestingly, the USA does not have disasters of extraordinary magnitude compared with Third World countries. In US history, only 6 disasters have had fatality rates >1000 *(Table)*, and only 10 to 15 disasters a year result in >40 injuries. The total number of deaths from US disasters from 1900 to 1967 is minimal compared with the number of highway deaths—53,000—in 1967 alone.

Disasters do more than cause unexpected deaths, injuries, and illnesses. Among their effects are the destruction of local health infrastructures—hospitals, doctor's offices, clinics, dialysis centers, pharmacies, and the like; the environmental impact, such as increased risk of communicable diseases, premature death, and decreased quality of life; psychological effects, including anxiety, neuroses, and depression; food shortages and nutritional consequences; and, in some places, large population movements.

In the sections that follow, I provide an overview of some natural and man-made disasters, specific clinical entities related to disasters, disaster planning, and the future of disaster medicine.

From the Department of Emergency Medicine, Baylor University Medical Center, Dallas, Texas; and the Division of Emergency Medicine, Department of Surgery, The University of Texas Southwestern Medical Center at Dallas.

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Corresponding author: Joseph Zibulewsky, MD, Department of Emergency Medicine, Baylor University Medical Center, 3500 Gaston Avenue, Dallas, Texas 75246 (e-mail: josephz@baylordallas.edu).

NATURAL DISASTERS

Floods

Floods account for 50% of disasters and deaths related to disasters. The worst natural disaster in recorded history was the flood of the Yellow River in China in 1887: 900,000 people died, and 2 million were left homeless. The Johnstown flood, which killed 2200 people, was the worst flood in the USA. Not surprisingly, 70% of all floods occur in India and Bangladesh, which have miles of low-lying coastal areas and poor infrastructures.

Causes of mortality and morbidity from floods include drowning, hypothermia, and trauma. People tend to underestimate the power of a flood; they think that if they can stand in the water, they will be fine. However, fast-flowing water can easily knock people off their feet; at that point, they can drown or be struck by debris. Automobiles, even large sport utility vehicles, are no protection in fast-moving water.

Although floods can be extensive, only 0.2% to 2% of people involved in a flood require medical care. Most injuries are minor, consisting of cuts, scrapes, and broken bones; however, without proper wound care, many skin wounds become infected. Other related problems include fires from broken gas lines and oil tanks; toxic waste from overflow of waste treatment plants; and even snake bites, particularly in India and the Philippines. Infections, such as shigellosis, salmonellosis, hepatitis A, typhoid, and diarrhea due to *Escherichia coli* can also spread through dirty water and sanitation runoff.

Cyclones

In the Caribbean and Western Atlantic, cyclones are called hurricanes; in the Western Pacific, they are called typhoons. A cyclone is a wind system that rotates counterclockwise (in the Northern Hemisphere) and has sustained winds >74 mph. The Galveston hurricane that occurred on September 8, 1900, and killed >6000 people was the worst disaster in US history.

People are injured in hurricanes in a number of ways. Storm surges, in which the ocean is literally picked up and dropped on a coastal area, are responsible for 90% of all cyclone-related fatalities. People are also injured by broken glass or debris caught up in the winds, by collapse of houses, and by mud slides. After the disaster, electrocutions can occur. The risk of electrocution is particularly high in mobile homes, where the wiring is not as well grounded. Another injury, which has been called "the cyclone syndrome," occurs when people hold on to trees in the midst of the rising water and wind; they tend to get abrasions on their chest and medial arms and thighs. Overall, mortality and morbidity rates related to cyclones remain low unless there is a storm surge or a flash flood. As with floods, most injuries consist of cuts and scrapes, which are often contaminated, as well as fractures.

Tornadoes

Tornadoes are the most lethal atmospheric condition; they have caused 9000 deaths over the past 50 years in the USA. Tornadoes can be up to a half-mile wide, travel up to 185 miles, and have winds up to 310 mph. About 700 tornadoes touch down in the USA each year, but only 3% cause casualties. Fortunately, most tornadoes touch down in uninhabited areas. The Midwest is one of the few parts of the world where a cold air mass can meet a warm, humid air mass and cause a tornado. In most other parts of the world where the 2 air masses could meet, there is an obstruction, such as a small mountain range or a large body of water.

Tornado-related causes of death include craniocerebral trauma and crush injuries of the chest and trunk. Fractures are the most common nonfatal injury. Wind speeds cause debris to be deeply impaled in the body, which frequently causes infections. Those who live in mobile homes are 40 times more likely and those in cars are 5 times more likely to be killed or injured than those in fixed structures.

Volcanoes

Volcanoes have caused 266,000 deaths in the past 400 years. The most lethal volcanoes in history have been Krakatoa in Indonesia, which caused 36,000 deaths; Mount Pelee in Martinique, which caused 28,000 deaths; and Nevada del Ruiz in Columbia, which caused 25,000 deaths. Fortunately, when Mount St. Helens erupted in the USA, few people lived at the base or downwind. In addition, Mount St. Helens was the most studied volcano in history; researchers knew that it was going to erupt, so people were prepared for it. Mount Rainier, which is just north of Mount St. Helens, is expected to erupt sometime in the next 50 years. Should the winds take the ash and debris north and west, the city of Seattle could be severely affected.

The principal cause of death from volcanoes is asphyxia from ash inhalation. Eighteen of the 23 immediate deaths from Mount St. Helens were caused by asphyxia. Other mechanisms of morbidity include scalding from the superheated steam, the release of toxic gases, explosions, lava flows, and earthquakes.

Earthquakes

Earthquakes have caused more than 1 million deaths worldwide in the past 20 years. In the USA, the 1906 San Francisco earthquake caused 700 deaths; the 1971 San Fernando earthquake, 64; and the 1989 Loma Prieta that flattened the Nimmitz Freeway, 67. The decreasing number of deaths despite increasing population densities is a testament to our improved engineering safety.

The principal cause of earthquake-related deaths is collapse of buildings, which causes crush injuries, hemorrhage and shock, drownings if the earthquake is near a coast, asphyxia from the crush or from heavy dust, hypothermia from being left homeless, and sepsis from wounds. Rescue efforts are most effective in the first 24 to 48 hours after the earthquake.

Most morbidity from earthquakes does not require hospital admission. As with other disasters, the injuries are usually cuts, scrapes, minor fractures, and minor head injuries. Chronic illnesses could also be exacerbated because of the lack of medical or hospital facilities.

MAN-MADE DISASTERS

There are many types of man-made disasters. On an individual basis, planes, trains, and automobiles are principal sources. Engineering disasters, such as the collapse of the Hyatt Regency skywalk in Kansas City, can kill and injure groups of people. When large numbers of people gather for a concert or a sporting event, mass casualty incidents can occur—when people are crushed, for example. Many papers have been written outlining medical needs for these large events, including the numbers of doctors and nurses needed and the amount of water needed to keep people from becoming hyperthermic or dehydrated in the heat. I will focus on 2 man-made disasters: hazardous materials and radiation.

Hazardous materials

There are approximately 53,000 "dangerous" chemicals in the workplace; toxicity information is available for only half of them. Health care personnel may see 5 or 6 workers who were exposed to organophosphates in their workplace or large numbers of people exposed because of a release into the community. Recently, a tanker that was carrying thousands of tons of solvents to make plastics sank in the North Atlantic near England. The sinking of the ship did not affect the community but polluted the water; if the ship was instead a train going through downtown Dallas, the situation would have been much different. In Texas, 3.5 hazardous materials releases occur each day. In essence, the Oklahoma City bombing was a problem with 2 hazardous materials: ammonium nitrate and diesel oil.

Unfortunately, most emergency departments are poorly prepared for hazardous materials disasters. Baylor University Medical Center's level 1 trauma center has one decontamination room—a negative pressure room, which has tile floors, a hose for rinsing people off, and a tank underneath the floor to trap contaminated water. Baylor can certainly treat a handful of workers exposed to pesticides but would be hard-pressed to quickly treat a large group exposed in a major industrial accident. Very few institutions have the extra personal protective clothing needed, including respirator suits, and very few have significant experience with hazardous materials. In my 12 years' experience in emergency medicine, I have seen 2 hazardous materials incidents, neither of which was very serious.

Hazardous materials can reach people through inhalation, skin absorption, or ingestion. Among the inhaled toxins are the asphyxiants, such as carbon dioxide, nitrogen, and methane, which displace oxygen. Those who inhale them are unaware of a problem, since these agents cause no irritation and no physical damage. Respiratory irritants, such as ammonia, phosgene, and chlorine, are more obvious; they cause edema, secretions, and laryngospasms. Systemic toxins, such as carbon monoxide, and hydrocarbons, such as benzene, toluene, and methylchloride, can also be inhaled.

Pesticides are the classic example of toxins absorbed through the skin. However, chemical burns are another mechanism of skin absorption. These burns require extensive irrigation. Alkaline burns are more severe than acid burns: when acid burns skin or eyes, it sets up a layer of scar tissue in front of the burn, which prevents the acid from penetrating too deeply into the tissues. Alkaline burns, however, actually liquefy the tissues; thus, no layer of scar tissue forms, and the burn can progress much deeper, causing more extensive damage. Getting splashed in the eye with drain cleaner, then, is much worse than getting splashed in the eye with battery acid.

Radioactive disasters

Radioactive disasters are probably the most feared by the public, although historically there have been relatively few victims. Only 5 events worldwide have prompted disaster responses. Nevertheless, a radioactive disaster can have far-reaching consequences. The explosion at Chernobyl left a radioactive cloud that covered half of the earth. The biggest risks come from nuclear reactors and from transportation of radioactive material. Cancer therapy agents, for example, are transported all over the country. If a truck or train carrying this material were involved in a collision, large numbers of people could be exposed to radiation.

Radiation consists of alpha, beta, and gamma particles. Alpha particles are the least penetrating, while beta particles can penetrate skin and gamma particles can easily pass through the human body and be absorbed by the tissues. All radiation damage is caused by penetration into the body. Geiger counters can detect beta and gamma particles; a special counter is needed for alpha particles.

Three types of contamination with radiation are possible. With external radiation exposure, the person is not radioactive. An example would be receiving an accidentally high dose of radiation through a computed tomography scanner. With contamination, gas, liquids, or solids are deposited on the body, and decontamination is required before the patient can enter the hospital. The most severe form of contamination is incorporation, in which radioactive atoms are taken up within cells or body structures and cause damage. Generally, radium and strontium are deposited in the bones and radioactive iodine within the thyroid.

Absorption of radiation is measured with the unit Grey: 1 Gy causes nausea and vomiting in 6 to 12 hours; 2 to 3 Gy, nausea and vomiting in a couple of hours. Patients who absorb 5 Gy have a 50% rate of mortality from bone marrow depression. The absolute lymphocyte count is a good indicator of toxicity, with $<100/\mu L$ usually portending a fatal outcome. Absorption of 10 Gy leads to gastrointestinal syndrome with massive bloody diarrhea, which is also usually fatal.

Chernobyl was an example of contamination. The explosion caused radioactive substances to be deposited on people. In addition, the environment was contaminated, leading to contamination of the food chain. Fish died in the lakes, and people died for weeks and months to come. Other large-scale episodes of contamination occurred in Goiania, Brazil, and Juarez, Mexico, where people found cobalt cancer therapy units lying around after the destruction of hospitals and took home the green, glowing balls of cobalt for their children to play with. Hundreds of people were contaminated, and it took the health care system some time to identify the cause of the multiple cases of nausea, vomiting, and diarrhea being reported.

UNIQUE CLINICAL ENTITIES IN DISASTERS

Blast injuries and crush injuries are common in disasters, and I will address those. In addition, I will address the incidence of infectious diseases following a disaster.

Blast injuries

Blast injuries are caused by high-energy explosives—TNT and plastic explosives like those used on the *USS Cole*—plus any of the nuts, bolts, nails, and other materials sometimes added to bombs. High-energy explosives explode rapidly, in contrast to gun powder, which fizzles. They cause brisance, the shattering of objects. The initial pressure wave of a high-energy explosion travels at 800 m/sec; the intensity depends on the size of the explosion, the distance from it, and the surrounding medium. The pressure wave travels faster and harder through water than through air. Following the pressure wave is a negative pressure phase—a longer period of suction formed by the vacuum of the initial wave. If the initial pressure wave didn't break some windows, the negative pressure wave will.

A number of different injuries are caused by the blast wave. The lungs, ears, and gastrointestinal tract are most susceptible. Injuries are caused by 4 mechanisms. The first, spalling or brisance, involves the movement of particles from more to less dense areas, as when liquid in the lungs moves into the gas area of the alveoli and causes pulmonary hemorrhage. Implosion, which is compression and decompression of gaseous compartments with rupture, can cause rupture of tympanic membranes. With inertia, the human body is thrown against a stationary object. Finally, with pressure differentials, the blast wave drives fluids from their spaces. This is another cause of delayed pulmonary hemorrhage, which can cause death hours or even days after the explosion. Among secondary injuries are cuts caused by flying glass, shrapnel, and debris that can imbed deeply into tissues. Tertiary injuries occur as people are thrown against hard surfaces. Burns and smoke inhalation are additional related problems.

Most blast fatalities are from brain injuries, skull fractures, diffuse lung contusions, and liver lacerations. Tympanic membrane rupture is a sign of being close to the blast and thus a marker for more serious injuries. Only about 15% of those who come to the emergency department for blast injuries are admitted to the hospital; others are either well enough to go home or do not survive the initial blast.

Crush injuries

Crush injuries occur as people are trapped under collapsed buildings. A major problem of crush injuries is rhabdomyolysis, i.e., muscle crush and subsequent breakdown. Half of those with severe rhabdomyolysis will go into renal failure, since myoglobin is toxic to the kidneys. The risk of kidney failure increases with delays in fluid therapy. Once renal failure has developed, the mortality rate is 20% to 40%, even with dialysis. Most people who survive crush injuries in earthquakes are rescued early; the longer they lie under buildings, the bigger risk they have of dying from rhabdomyolysis.

Compartment syndrome is seen with crush injuries as well. A forearm, for instance, has 2 compartments, dorsal and volar. If one of the compartments is crushed and becomes filled with blood, the pressure inside it increases, neurologic and vascular flow to the distal extremity is lost, and eventually that area will undergo necrosis and require amputation. Treatment for compartment syndrome is an early fasciotomy to release the pressure.

Traumatic asphyxia results from chest compression, which interferes with respiration and increases intrathoracic pressure. Blood is forced up into the head, and blood flow back to the heart is decreased. The injured get cyanosis, petechiae in the head and neck, and subconjunctival hemorrhages.

Infectious diseases

Disasters cause a breakdown of the usual mechanisms of infection control: safe nutrition, potable water, access to health care, and vector control. Such problems are worse in the developing world than in the industrialized world, but much can also depend on climate. In cold weather, people crowd together and spread diseases; in warm weather, vectors such as mosquitoes can become a problem. Disasters do not introduce new pathogens. Instead, infectious diseases are caused by pathogens endemic to the area or brought in by refugees. Because of this, mass vaccines are rarely useful, except for the measles vaccine, which has proven useful in past disasters.

An example of an infectious disease following a disaster is pulmonary coccidioidomycosis, which was seen after the 1994 Northridge earthquake because of increased dust levels. In Southern California, coccidioidomycosis increases every time construction work begins and the dry dirt in which it lives is disrupted and turned into dust, allowing it to be carried with the wind. Another example is the increased incidence of giardiasis in Montana in 1980 after the eruption of Mount St. Helens. The ashfall caused heavy water runoff secondary to obstructed creeks and streams and thus an increase in the pathogen in that area.

Some increases in the incidence of infection are due to host factors. People may not tend a wound carefully after a disaster. They may be malnourished and dehydrated, and the psychological stress from the disaster also takes its toll on their immune systems.

DISASTER RESPONSE

There existed no well-organized studies of disasters from an epidemiologic point of view until the 1976 Guatemalan earthquake. The group of investigators who studied this disaster identified 3 myths of disaster response. The first myth was that foreign medical volunteers with any kind of medical background were needed in a disaster. In reality, most of the immediate needs in a Third World disaster are met by the local population. The second myth was that any kind of international assistance was needed and was needed quickly. Again, most needs are met by the local governments, and time is required to assess that need. The third myth was that epidemics and plagues were inevitable after a disaster. Researchers found that except for measles, this is not true. Contrary to what most people thought before 1976, dead bodies from a disaster do not spread disease, so burying dead bodies becomes less of an immediate priority.

The media dubbed the response of the industrialized world to the Guatemalan disaster as the "second disaster." No initial field assessment was conducted. No needs assessment was done. The industrialized world, namely the USA, sent 100 tons of materials, including vaccines and drugs, many of which were outdated; 90% of what was sent was not used. The antibiotics and pain medicines that were needed were not sent. In 1988, the USA sent 5000 tons of equipment and materials to Armenia in response to another devastating earthquake, and most of this was not needed either. It took 6 months for a large group of people just to catalog everything that arrived. After years of research, the World Health Organization developed an emergency health kit that contains the essential materials needed after a disaster—including antibiotics and supplies for wound care and surgical care.

Overall, disaster response should consist of 3 phases: activation, implementation, and recovery.

Activation phase

The first element in the activation phase is a 2- to 4-day survey to assess the geographical extent of damage; the number of people involved; the number of casualties; the integrity of the health care delivery system; the specific health care needs of survivors; the disruption of power, water, and sanitation; and the extent of the local response. Interestingly, most disasters in the Third World and in the USA are fairly similar from a public health point of view.

The activation phase continues with the establishment of communication and information relays. Research has shown that the most significant problems in a disaster recovery effort are in communication—particularly as 20 or 30 different agencies work in the area. In the 1970s, the Federal Emergency Management Agency (FEMA) developed the Incident Command System, a military-type command center that is set up at or near a disaster site. The senior official of the first responder team assumes the lead role, and actions follow a formalized chain of command.

Implementation phase

The first stage of the implementation phase is search and rescue. Initially, survivors among the local population do this work, dispelling another myth called the "disaster syndrome"; it was believed that, after disasters, the survivors walked around dazed and apathetic. In reality, even those who are somewhat injured pull together and quickly become involved in looking for survivors. Most lives are saved in the first day or two; however, many times the rescuers themselves can become victims.

When victims are found, they are triaged. Triage in a disaster is harsh. The goal is the greatest good for the greatest number. Whereas in our emergency departments, we will spend thousands of dollars and devote up to 10 staff members to saving the life of a person in extremis with a heart attack, on a disaster scene that person could be pushed to the side and left to die in order to better utilize available resources on more salvageable patients. Color-coded tagging systems are frequently used to identify those who have minor injuries, moderate injuries, or severe injuries. The black tag is reserved for persons who have died. Assessing status is a dynamic process, and initial assessments are accurate only 70% of the time. Medical personnel on site need to have some experience with this type of triage. It is a difficult task, especially for those of us who are used to saving everyone at all costs.

Once the patients are triaged, they are taken to various collection points. The first is a clearing and staging area a safe distance from the disaster. Patients receive basic medical interventions—intravenous lines, wound care, oxygen, pain medications, and splints. From there, they receive secondary assessment and further field treatment at a casualty collection point. Treatment at this stage may include needle thoracentesis, chest tubes, and preoperative antibiotics. The Medical Command System, a branch of the Incident Command System, determines which hospitals the patients will go to for definitive care and arranges for medically supported transport. There usually are not enough backboards and cervical spine collars for all the trauma patients, so the team members transport the victims as best they can.

In disasters, health care providers should do what they are good at. Paramedics should perform the initial assessment, triage, stabilization, and transport; they are poorly prepared to replace nurses in the hospital setting. Only physicians and nurses with special field training should be in the field, and physicians should not go to the field unless there is a surplus of physicians in the hospitals.

Recovery phase

The recovery phase consists of reassessing the scene for missed victims, withdrawing prehospital services, and debriefing those involved. Debriefing involves critical incident stress management. Health care workers assisting disaster victims often become stressed and depressed. Professionals within FEMA help the workers to vent and resolve their feelings.

Hospitals during disasters

The disaster system is set up to triage patients and distribute them to hospitals. However, as many as 50% of the victims bypass this system and arrive at the hospital in private cars, police cars, taxis, or buses. This causes a maldistribution of patients: some hospitals are overwhelmed while others are left vacant. I experienced this during the 1992 Los Angeles riots. In the emergency department at the University of California at Los Angeles, we were expecting the worst but had a very quiet night. In the meantime, Daniel Freeman Hospital, situated closer to the riots, received 25 patients with gunshot wounds in a 3-hour period. The emergency management system was taking patients to the nearest hospitals, but because of the overwhelming number of patients, the city's system for distributing them fell apart completely.

Even after disasters are over, the emergency department will have higher patient volumes than normal. Some people will be injured in the cleanup process. The loss of doctor's offices and clinics will bring more people to the hospital for care of chronic diseases. Heat- and cold-related problems may appear, as well as somatic symptoms from psychological trauma.

Disaster plans

The Joint Commission on Accreditation of Healthcare Organizations mandates the creation and testing of hospital disaster plans. At Baylor, we conduct a disaster drill twice a year. Nevertheless, we probably experience the "paper plan syndrome." Although the plans are written down on paper, holes become evident as they are put into action. We have found problems during our drills and have addressed those problems, but more holes may surface under different circumstances.

In 1994, the emergency department experienced an internal disaster: a flood. The basement of Roberts Hospital had a foot of water in it. It was about 9 PM on a Friday, and we were able to move the 10 or 12 patients in the department to the recovery room. We discharged those who could be discharged, admitted those we could admit, and closed by 3 AM. The emergency department remained closed for a week, until the damage could be repaired. Other possibilities for internal disasters are power failures, chemical or radiation accidents, fires and explosions, bomb threats, and elevator problems.

Baylor University Medical Center's disaster plan addresses a plan of activation, a command center (which is the emergency department), traffic flow, triage, decontamination, treatment areas, special areas (such as family areas and a morgue), and evacuation.

The role of the federal government in disasters

President Carter established FEMA in 1979. It includes under its auspices the National Fire Administration, Civil Defense, and insurance programs, and it can call upon other federal agencies as needed, including the Department of Transportation, the US Army Corps of Engineers, the Environmental Protection Agency, and the Department of Agriculture. FEMA does not respond to disasters on its own accord but only at the invitation of a governor. FEMA had management problems in the 1980s but since that time has become much more efficient and responsive to the needs of disaster victims. One improvement made in 1992 was the development of the Federal Response Plan, in which the American Red Cross joined resources with the 26 federal agencies under FEMA.

The National Disaster Medical System is another disaster-relief program; it was initiated in 1981 and consists of volunteer disaster teams (presently 61 of them) that can be rapidly assembled and taken to a disaster site. Each team is self-sufficient, with about 35 medical and support personnel. Teams can be deployed for up to 2 weeks.

An example of how the government should not work occurred in the 1970s, when a state bank building in Crested Butte, Colorado, exploded, killing or injuring a number of people. Because it was a bank building, the Federal Bureau of Investigation became involved. Because it was an explosion, the Bureau of Alcohol, Tobacco, and Firearms became involved. Initially it was thought that the explosion resulted from coal gas from an underground mine, so the US Mine Safety Commission joined in the investigation, which also brought in the US Geological Survey because of the mine. That idea was discounted, but then it was thought that the explosion could have resulted from a propane leak, so the National Transportation Safety Board became involved, and because it was a hazardous substance, the Occupational Safety and Health Administration became involved. For the explosion of one isolated building, then, 6 or 7 different federal agencies were involved—all overlapping, all redundant, all looking at the situation from their own point of view, without anyone coordinating the efforts. That type of redundancy and lack of communication should have been eliminated by the coordination of federal programs under the auspices of FEMA.

FUTURE OF DISASTER MEDICINE: BIOTERRORISM

All disasters are low-probability events. Even when they do happen, at least in the USA, there are few casualties. Because of this, people tend to become apathetic: "What's going to happen will happen. What control do I have over it?" This is a major obstacle in dealing with the future threat of bioterrorism. President Clinton has said that we are going to have a biological terrorist attack sometime in the next 20 or 30 years. Interest in bioterrorism has been piqued somewhat because of the Oklahoma City bombing, the sarin attack in Tokyo, and the gas attacks in the Iran-Iraq War.

A number of studies are reporting that emergency departments are poorly prepared for bioterrorism. First, it might be difficult even to know if an attack has occurred. Symptoms from some biological weapons are mild and nonspecific, such as nausea and vomiting. It is difficult enough for us to detect common causes of these symptoms, such as infectious diseases or food poisoning, since there is no national data bank or reporting system for such diseases. In one night, 30 or 40 people in this city could show up at various emergency departments with the exact same gastrointestinal symptoms. We wouldn't call each other and say, "Do you have somebody with nausea and vomiting in your emergency department?" Physicians have to have a high degree of suspicion, but when a patient presents with nausea and vomiting, bioterrorism is not the first thing that comes to mind.

We also have a limited ability to treat victims. In the sarin attack, 74% of the patients seen had no injuries; that is part of the mass hysteria effect. One hospital served 641 patients in a single day. (We see 250 patients on a busy day in our emergency department.) In addition, 20% of the hospital staff treating the sarin victims were themselves contaminated. Federal plans do not take into account individual hospital capabilities, and some hospitals are not very well prepared to take care of disaster victims. Unfortunately, that puts the burden on those hospitals that are better prepared to care for contaminated patients. As a level 1 trauma center in a major metropolitan area, Baylor will need to play a leading role in the preparation for bioterrorism and in the care of citizens who fall victim to such attacks. Hopefully, this article and the articles on bioterrorism to appear in the July 2001 issue will help increase awareness of the problems we face as a major medical center and so help to improve our response to such disasters, saving lives in the process.

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