Public health issues in disasters

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Objective: **This article outlines a number of important areas in which public health can contribute to making overall disaster management more effective. This article discusses health effects of some of the more important sudden impact natural disasters and potential future threats (e.g., intentional or deliberately released biologic agents) and outlines the requirements for effective emergency medical and public health response to these events.**

Conclusion: **All natural disasters are unique in that each affected region of the world has different social, economic, and health backgrounds. Some similarities exist, however, among the health effects of different natural disasters, which if recognized, can ensure that health and emergency medical relief and limited resources are well managed. (Crit Care Med 2005; 33[Suppl.]:S29–S33)**

KEY WORDS: disasters, natural, earthquake, flood, volcano, tornado, hurricane, typhoon, cyclones; disaster epidemiology; disaster medicine; emergency; mass casualty incident; homeland security

Throughout history, natural disasters have exacted a heavy toll of death and suffering (1). Most recently, the Bam earthquake in Iran resulted in thousands of deaths, injuries, and homelessness (2) (Table 1). The problem has not improved much despite much attention by the international scientific community (3). Global climate change brings the potential for severe weather events and flooding, and the introduction of tropical vector-borne diseases into more temperate regions (4, 5). Increasing population density near coasts, in floodplains, and in regions of high points to the probability of future catastrophic natural disasters with millions of casualties.

Disasters affect a community in numerous ways. Roads, telephone lines, and other transportation and communication links are often destroyed (6). Public utilities and energy supplies may be disrupted (7). Substantial numbers of victims may be rendered homeless (8). Portions of the community's industrial or economic base may be destroyed or damaged. Casualties may require medical care, and damage to food sources and utilities may create public health threats (9, 10). The more remote the area, the longer it takes for external assistance to arrive, and the more the community will have to rely on its own resources, at least for the first several hours, if not days (11). Good disaster management requires accurate information and must link data collection and analysis to an immediate decision-making process (12). The overall objective of disaster management from a public health perspective is to assess the needs of disaster-affected populations (13, 14), match available resources to those needs, prevent further adverse health effects, implement disease control strategies for well-defined problems, evaluate the effectiveness of disaster relief programs (15), and improve contingency plans for various types of future disasters (16). Common patterns of morbidity and mortality after certain disasters can be identified (17) (Table 2). Effective emergency medical response depends on anticipating these different medical and health problems before they arise (18) and on delivering the appropriate interventions (relief supplies, equipment, and personnel) at the precise times and places where they are needed most (19).

CRITICAL PUBLIC HEALTH INTERVENTIONS AFTER DISASTERS

Critical public health interventions after disasters focus on the following areas.

Environmental Health: Water, Sanitation, Hygiene, and Vector Management

General Issues. Overcrowding and resulting poor water supplies and inadequate hygiene and sanitation are well-known factors that are known to increase the incidence of diarrhea, respiratory infections, and other communicable diseases. A good system of water supply and excreta disposal must be put into place quickly (20). No amount of curative health measures can offset the detrimental effects of poor environmental health planning (21). Important postdisaster environmental interventions include access to adequate sources of potable water; and the collection, disposal, and treatment of excreta and other liquid and solid wastes (22). This is achieved through installation of an appropriate number of suitably located excreta disposal facilities such as toilets, latrines, or defecation fields; solid waste pickup points; water distribution points; and availability of bathing and washing facilities and of soap together with effective health education. The control of disease vectors such as mosquitoes, flies, rats, and fleas is an important part of an environmental health approach to protecting community members from disease (23).

Water and Excreta Disposal. Adequate quantities of relatively clean water are preferable to small amounts of high-quality water. Each person must receive a minimum of 15 to 20 L of clean water per day for their domestic needs (24). Unfortunately, it is frequently difficult to provide even these minimum quantities of water to disaster-affected populations (25). During this early acute phase, latrine construction begins, but initial sanitation measures may be nothing more than simply designating an area for defecation, hopefully segregated from the

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community's source of potable water. Construction of one latrine for every 20 persons is recommended but is rarely achieved in camp settings (24).

Shelter. Surveys of settlements and towns around Managua, Nicaragua, after the December 1972 earthquake indicated that 80% to 90% of the 200,000 displaced persons were living with relatives and friends; 5% to 10% were living in parks, city squares, and vacant lots; and the remainder were living in schools and other public buildings (26). Regarding temporary living space allocations, 3.5 square meters is the absolute minimum floor space per person in emergency shelters (24). The first priority in areas where large numbers of people are living in damaged housing is to diminish as much as possible the penetration of wind and rain into the structure. In these situations, plastic sheeting for roof and window repairs along with the required materials for attaching them to the damaged structures are often provided by relief organizations. Most people who lose their homes will initially be able to take shelter with friends and relatives (27). Only when housing losses reach more than approximately 25% will there be a need to find other forms of shelter (26).

The decision to provide shelter at all can have significant long-term consequences, especially in poor communities. For example, simple shelters provided on an emergency basis may unintentionally evolve into permanent shantytowns or squatter settlements and end up attracting many more homeless people to the site.

Table 1. Selected natural disasters 1970–2004

Year	Event	Location	Approximate Death Toll
1970	Earthquake/landslide	Peru	70,000
1970	Tropical cyclone	Bangladesh	300,000
1971	Tropical cyclone	India	25,000
1972	Earthquake	Nicaragua	6,000
1976	Earthquake	China	250,000
1976	Earthquake	Guatemala	24,000
1976	Earthquake	Italy	900
1977	Tropical cyclone	India	20,000
1978	Earthquake	Iran	25,000
1980	Earthquake	Italy	1,300
1982	Volcanic eruption	Mexico	1,700
1985	Tropical cyclone	Bangladesh	10,000
1985	Earthquake	Mexico	10,000
1985	Volcanic eruption	Columbia	22,000
1988	Hurricane Gilbert	Caribbean	343
1988	Earthquake	Armenia SSR	25,000
1989	Hurricane Hugo	Caribbean	56
1990	Earthquake	Iran	40,000
1990	Earthquake	Philippines	2,000
1991	Tropical cyclone	Bangladesh	140,000
1991	Volcanic eruption	Philippines	800
1991	Typhoon/Xood	Philippines	6,000
1991	Flood	China	1,500
1992	Hurricane Andrew	USA	52
1993	Earthquake	India	10,000
1995	Earthquake	Japan	6,000
1998	Hurricane Mitch	Central America	10,000
1999	Earthquake	Turkey	18,000
1999	Earthquake	Taiwan	1,000
2001	Earthquake	India	20,000
2003	Earthquake	Algeria	3,000
2004	Earthquake	Iran	25,000

Data from Office of U.S. Foreign Disaster Assistance: *Disaster history: Significant data on major disasters worldwide, 1900–Present*. Washington, DC, Agency for International Development, 2004; and National Geographic Society: *Nature on the rampage, our violent earth*. Washington, DC, National Geographic Society, 1987.

COMMUNICABLE DISEASE CONTROL AND EPIDEMIC MANAGEMENT

Epidemics

Natural disasters are often followed by rampant rumors of epidemics (such as typhoid or rabies) or unusual conditions such as increased snakebites and dog bites. Such unsubstantiated reports gain great public credibility when printed as facts in newspapers or reported on television or radio (28). For example, after disasters in developing countries, any disruption of the water supply or sewage treatment facilities has usually been accompanied by rumors of outbreaks of cholera or typhoid (29). Such rumors may well have reflected psychologic fears and anxieties about a disastrous event rather than the true perception of an imminent problem. However, informa-

Table 2. Short-term effects of major natural disasters

Effects	Earthquakes	High Winds (Without Flooding)	Tsunamis	Floods/Flash Floods
Deaths	Many	Few	Many	Few
Severe injuries requiring extensive care	Overwhelming	Moderate	Few	Few
Increased risk of communicable	Potential (but small) risk following all major disasters (probability rises as overcrowding diseases increases and sanitation deteriorates)			
Food scarcity	Rare	Rare	Common	Common
	(May occur because of factors other than food shortage)			
Major population movements	Rare	Rare	Common	Common
	(May occur in heavily damaged urban areas)			

Modified from Office of Emergency Preparedness and Disaster Relief Coordination: *Emergency Health Management After Natural Disaster*. Washington, DC, Pan American Health Organization, 2002.

tion on disease incidence in most developing countries is poor, and some outbreaks may have been missed entirely by public health authorities.

Although natural disasters do not usually result in outbreaks of infectious disease, under certain circumstances, disasters may increase disease transmission. The risk of epidemic outbreaks of communicable diseases is proportional to population density and displacement. These conditions increase the pressure on water and food supplies and the risk of contamination (like in refugee camps), the disruption of preexisting sanitation services such as piped water and sewage, and the failure to maintain or restore normal public health programs in the immediate postdisaster period. The most frequently observed increases in communicable disease are caused by fecal contamination of water and by respiratory spread (for example, flu in evacuation camps) (30). In the longer term, an increase in vector-borne diseases occurs in some areas because of disruption of vector control efforts, particularly after heavy rains and floods. Residual insecticides may be washed away from buildings, and the number of mosquito breeding sites may increase. Moreover, displacement of wild or domesticated animals near human settlements brings additional risk of zoonotic infection.

Disposition of Dead Bodies

The public and government authorities are usually greatly concerned about the danger of disease transmission from decaying corpses. Responsible health authorities should recognize, however, that health hazards such as epidemics associated with unburied bodies are minimal, particularly if death resulted from trauma. It is far more likely that survivors will be a source of disease outbreaks. Although the risks for rescue workers who handle dead bodies are higher than for the survivors of a disaster, those risks can be limited through a set of simple measures. Appropriate precautions include training military personnel and others who might have to provide assistance after a disaster, vaccinating those persons against hepatitis B and tuberculosis, using body bags and disposable gloves, washing hands after handling cadavers, and disinfecting stretchers and vehicles that have been used to transport bodies (31).

Unjustified worries about the infectiousness of bodies can lead to the rapid, unplanned disposal of the dead, sometimes before proper identification of the victim has been made, as well as to taking needless "precautions" such as mass cremation, burying the deceased in common graves, and adding chlorinated lime as a "disinfectant." Despite the negligible health risk, dead bodies represent a delicate social problem. Disposal of bodies should respect local custom and practice when possible. When there are large numbers of victims, burial is likely to be the most appropriate method of disposal. There is little evidence that proper burial of bodies poses a threat to groundwater that serves as a source of drinking water (32).

Immunization

Mass immunization during situations of natural disasters is usually counterproductive and diverts limited human resources and materials from other more effective and urgent measures. Immunization campaigns can give a false sense of security, leading to the neglect of basic measures of hygiene and sanitation, which are more important during the emergency. Mass vaccination would be justified only when the recommended sanitary measures do not have an effect and if there is evidence of the progressive increase in the number of cases with the risk of an epidemic. A vaccine with the following characteristics could be considered useful in this situation:

- A vaccine of proven efficacy, high safety, and low reactogenicity;
- A vaccine that is easy to apply (single-dose);
- A vaccine that confers rapid and long-lasting protection for people of all ages;
- Sufficient quantities of vaccine should be available to guarantee the supply for the entire population at risk; and
- Low-cost vaccines.

For example, immunization of children against measles is one of the most important (and cost-effective) preventive measures in emergency-affected populations, particularly those housed in camps. Immunization of refugee children against measles in Thailand in 1979 clearly saved many lives. Although measles was an early problem in Somalia, immunization of the refugee population was effective in preventing outbreaks after 1981 (33). Because infants as young as 6 mos of age may contract measles in refugee camp outbreaks and are at greater risk of dying as a result of impaired nutrition, it is recommended that measles immunization programs along with vitamin A supplements in emergency settings target all children from the ages of 6 mos through 5 yrs (some would recommend as old as 12–14). Ideally, one should strive for measles immunization coverage in refugee camp settings of better than 80% (24).

Nutrition

Food shortages in the immediate aftermath of a disaster may arise in two ways. Food stock destruction within the disaster area may reduce the absolute amount of food available, or disruption of distribution systems may curtail access to food, even if there is no absolute shortage. Generalized food shortages severe enough to cause nutritional problems usually do not occur after natural disasters. Flooding and sea surges can damage household food stocks and crops, disrupt distribution, and cause major local shortages. Food distribution, at least in the short term, is often a major and urgent need, but large-scale importation/donation of food is not usually necessary (34). In extended droughts such as those occurring in Africa, or in complex disasters, the homeless and refugees may be completely dependent on outside sources for food supplies for varying periods of time (35). Depending on the nutritional condition of these populations, especially of more vulnerable groups such as pregnant or lactating women, children, and the elderly, it may be necessary to institute emergency feeding programs (36). The highest nutritional priority in the postdisaster setting is the timely and adequate provision of food rations containing at least 2,100 calories and that includes sufficient protein, fat, and micronutrients (24).

MYTHS AND REALITIES OF NATURAL DISASTERS

Many mistaken assumptions are associated with the impact of disasters on public health. Disaster planners and managers should be familiar with the following myths and realities (37):

Myth: volunteers with any kind of medical background are needed.

Reality: the local population almost always covers immediate lifesaving needs. Only medical personnel with

skills that are not available in the affected community may be needed.

Myth: any kind of assistance is needed, and it is needed immediately!

Reality: a hasty response that is not based on an impartial evaluation only contributes to the chaos. It is better to wait until genuine needs have been assessed. In fact, most needs are met by the victims themselves and their local government and agencies, not by external relief agencies (38).

Myth: epidemics and plagues are inevitable after every disaster.

Reality: epidemics do not spontaneously occur after a disaster, and dead bodies will not lead to catastrophic outbreaks of exotic diseases. The key to preventing disease is to improve sanitary conditions and educate the public (39).

Myth: disasters bring out the worst in human behavior (e.g., looting, rioting).

Reality: although isolated cases of antisocial behavior exist, most people respond spontaneously and generously (40).

Myth: the affected population is too shocked and helpless to take responsibility for their own survival.

Reality: on the contrary, many find new strength during an emergency, as evidenced by the thousands of volunteers who spontaneously united to sift through the rubble in search of victims after the 1985 Mexico City earthquake.

Myth: disasters are random killers.

Reality: disasters strike hardest at the most vulnerable groups such as the poor, especially women, children, and the elderly.

Myth: locating disaster victims in temporary settlements is the best alternative.

Reality: it should be the last alternative. Many agencies use funds normally spent for tents to purchase building materials, tools, and other construction-related support in the affected community.

SUMMARY

This article discusses health effects of disasters and outlines the requirements for effective emergency medical and public health response to these events (41). Sound epidemiologic knowledge of the causes of death and of the types of injuries and illnesses caused by disasters is clearly essential when determining what relief supplies, equipment, and personnel are needed to respond effectively in emergency situations (42). The overall objective of disaster management is to assess the needs of disaster-affected populations, to match resources to needs efficiently, to prevent further adverse health effects, to evaluate relief program effectiveness, and to plan for future disasters (43, 44).

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