

# CHAPTER 1.

## GENERAL EFFECTS OF DISASTERS ON HEALTH

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In the past, sudden-impact disasters were believed to cause not only widespread death, but also massive social disruption and outbreaks of epidemic disease and famine, leaving survivors entirely dependent on outside relief. Systematic observation of the effects of natural disasters on human health has led to different conclusions, both about the effects of disaster on health and about the most effective ways of providing humanitarian assistance.

The term “disaster” usually refers to the natural event (e.g., a hurricane or earthquake) in combination with its damaging effects (e.g., the loss of life or destruction of buildings). “Hazard” refers to the natural event, and “vulnerability” to the susceptibility of a population or system (e.g., a hospital, water supply and sewage system, or aspects of infrastructure) to the effects of the hazard. The probability that a particular system or population will be affected by hazards is known as the “risk.” Hence, risk is a function of the vulnerability and the hazard, and is expressed as follows:

$$\text{Risk} = \text{Vulnerability} \times \text{Hazard}$$

Though all disasters are unique in that they affect areas with different levels of vulnerability and with distinct social, health, and economic conditions, there are still similarities between disasters. If recognized, these common factors can be used to optimize the management of health humanitarian assistance and use of resources (see Table 1.1). The following points should be noted:

1. There is a relationship between the type of disaster and its effect on health. This is particularly true of the immediate impact in causing injuries. For example, earthquakes cause many injuries requiring medical care, while floods and tidal waves cause relatively few.
2. Some effects are a potential, rather than an inevitable, threat to health. For example, population movement and other environmental changes may lead to increased risk of disease transmission, although epidemics generally do not result from natural disasters.
3. The actual and potential health risks after a disaster do not all occur at the same time. Instead, they tend to arise at different times and to vary in importance within a disaster-affected area. Thus, casualties occur mainly at the time and place of impact and require immediate medical care, while the risks of increased disease transmission take longer to develop and are greatest where there is overcrowding and standards of sanitation have declined.

**TABLE 1.1. Short-term effects of major disasters.**

Effect	Earthquakes	High winds (without flooding)	Tidal waves/flash floods	Slow-onset floods	Landslides	Volcanoes/ Lahars
Deaths <sup>a</sup>	Many	Few	Many	Few	Many	Many
Severe injuries requiring extensive treatment	Many	Moderate	Few	Few	Few	Few
Increased risk of communicable diseases	Potential risk following all major disasters (Probability rising with overcrowding and deteriorating sanitation)					
Damage to health facilities	Severe (structure and equipment)	Severe	Severe but localized	Severe (equipment only)	Severe but localized	Severe (structure and equipment)
Damage to water systems	Severe	Light	Severe	Light	Severe but localized	Severe
Food shortage	Rare (may occur due to economic and logistic factors)		Common	Common	Rare	Rare
Major population movements	Rare (may occur in heavily damaged urban areas)			Common (generally limited)		

<sup>a</sup>Potential lethal impact in absence of preventive measures.

4. Disaster-created needs for food, shelter, and primary health care are usually not total. Even displaced people often salvage some of the basic necessities of life. Furthermore, people generally recover quickly from their immediate shock and spontaneously engage in search and rescue, transport of the injured, and other private relief activities.
5. Civil wars and conflicts generate a distinct set of public health problems and operational constraints. They are not covered in any depth in this publication.

Effective management of health humanitarian aid depends on anticipating and identifying problems as they arise, and delivering specific materials at the precise times and points where they are needed. The logistical ability to transport maximum numbers of supplies and personnel from abroad to disaster areas in Latin America and the Caribbean is less essential. Cash is the most effective donation, particularly since it can be used to purchase supplies locally.

## HEALTH PROBLEMS COMMON TO ALL NATURAL DISASTERS

### Social Reactions

After a major natural disaster, behavior only rarely reaches generalized panic or stunned waiting. Spontaneous yet highly organized individual action accrues as

survivors rapidly recover from their initial shock and set about purposefully to achieve clear personal ends. Earthquake survivors often begin search and rescue activities minutes after an impact and within hours may have organized themselves into groups to transport the injured to medical posts. Actively antisocial behavior such as widespread looting occurs only in exceptional circumstances.

Although everyone thinks his or her spontaneous reactions are entirely rational, they may be detrimental to the community's higher interests. A person's conflicting roles as family head and health official, for instance, have in some instances resulted in key relief personnel not reporting to duty until their relatives and property are safe.

Rumors abound, particularly of epidemics. As a result, considerable pressure may be put on the authorities to undertake emergency humanitarian work such as mass vaccinations against typhoid or cholera, without sound medical justification. In addition, people may be reluctant to submit to measures that the authorities think necessary. During warning periods, or after the occurrence of natural disasters, people are reluctant to evacuate, even if their homes are likely to be or have been destroyed.

These patterns of behavior have two major implications for those making decisions about humanitarian programs. First, patterns of behavior and demands for emergency assistance can be limited and modified by keeping the population informed and by obtaining necessary information before embarking on extended relief programs. Second, the population itself will provide most rescue and first aid, take the injured to hospitals if they are accessible, build temporary shelters, and carry out other essential tasks. Additional resources should, therefore, be directed toward meeting the needs that survivors themselves cannot meet on their own.

### **Communicable Diseases**

Natural disasters do not usually result in massive outbreaks of infectious disease, although in certain circumstances they do increase the potential for disease transmission. In the short-term, the most frequently observed increases in disease incidence are caused by fecal contamination of water and food; hence, such diseases are mainly enteric.

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 (as 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 post-disaster period.

In the longer term, an increase in vector-borne diseases occurs in some areas because of disruption of vector control efforts, particularly following 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 infections.

In complex disasters where malnutrition, overcrowding, and lack of the most basic sanitation are common, catastrophic outbreaks of gastroenteritis (caused by cholera or other diseases) have occurred, as in Rwanda/Zaire in 1994.

## **Population Displacements**

When large, spontaneous or organized population movements occur, an urgent need to provide humanitarian assistance is created. People may move to urban areas where public services cannot cope, and the result may be an increase in morbidity and mortality. If much of the housing has been destroyed, large population movements may occur within urban areas as people seek shelter with relatives and friends. Surveys of settlements and towns around Managua, Nicaragua, following 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. Following the earthquake that struck Mexico City in September 1985, 72% of the 33,000 homeless found shelter in areas close to their destroyed dwellings.

In internal conflicts, such as occurred in Central America (1980s) or Colombia (1990s), refugees and internally displaced populations are likely to persist.

## **Climatic Exposure**

The health hazards of exposure to the elements are not great, even after disasters in temperate climates. As long as the population is dry, reasonably well clothed, and able to find windbreaks, death from exposure does not appear to be a major risk in Latin America and the Caribbean. The need to provide emergency shelter therefore varies greatly with local conditions.

## **Food and Nutrition**

Food shortages in the immediate aftermath 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 do not occur after earthquakes.

Flooding and sea surges often 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.

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. 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.

## **Water Supply and Sanitation**

Drinking water supply and sewerage systems are particularly vulnerable to natural hazards, and the disruptions that occur in them pose a serious health risk. The systems are extensive, often in disrepair, and are exposed to a variety of hazards. Deficiencies in established amounts and quality of potable water and difficulties in

the disposal of excreta and other wastes result in the deterioration of sanitation, contributing to conditions favorable to the spread of enteric and other diseases.

### **Mental Health**

Anxiety, neuroses, and depression are not major, acute public health problems immediately following disasters, and family and neighbors in rural or traditional societies can deal with them temporarily. A group at high risk, however, seems to be the humanitarian volunteers or workers themselves. Wherever possible, efforts should be made to preserve family and community social structures. The indiscriminate use of sedatives and tranquilizers during the emergency relief phase is strongly discouraged. In industrialized or metropolitan areas in developing countries, mental health problems are reported to be significant during long-term rehabilitation and reconstruction and need to be dealt with during that phase.

### **Damage to the Health Infrastructure**

Natural disasters can cause serious damage to health facilities and water supply and sewage systems, having a direct impact on the health of the population dependent on these services. In the case of structurally unsafe hospitals and health centers, natural disasters jeopardize the lives of occupants of the buildings, and limit the capacity to provide health services to disaster victims. The earthquake that struck Mexico City in 1985 resulted in the collapse of 13 hospitals. In just three of those buildings, 866 people died, 100 of whom were health personnel. Nearly 6,000 hospital beds were lost in the metropolitan facilities. As a result of Hurricane Mitch in 1998, the water supply systems of 23 hospitals in Honduras were damaged or destroyed, and 123 health centers were affected. Peru reported that nearly 10% of the country's health facilities suffered damage as a result of El Niño events in 1997–1998.

## **IMMEDIATE HEALTH PROBLEMS RELATED TO THE TYPE OF DISASTER**

### **Earthquakes**

Usually because of dwelling destruction, earthquakes may cause many deaths and injure large numbers of people. The toll depends mostly on three factors.

The first factor is housing type. Houses built of adobe, dry stone, or unreinforced masonry, even if only a single story high, are highly unstable and their collapse causes many deaths and injuries. Lighter forms of construction, especially wood-frame, have proved much less dangerous. After the 1976 earthquake in Guatemala, for example, a survey showed that in one village with a population of 1,577, all of those killed (78) and severely injured had been in adobe buildings, whereas all residents of woodframe buildings survived. In the earthquake affecting the villages of Aiquile and Totora in Bolivia in 1998, 90% of deaths resulted from the collapse of adobe housing.

The second factor is the time of day at which the earthquake occurs. Night occurrence was particularly lethal in the earthquakes in Guatemala (1976) and Bolivia (1998), where most damage occurred in adobe houses. In urban areas with well-

constructed housing but weak school or office structures, earthquakes occurring during the day result in higher death rates. This was the case in the 1997 earthquake that struck the towns of Cumaná and Cariaco, Venezuela. In Cumaná an office building collapsed, and in Cariaco two schools collapsed, accounting for most of the dead and injured.

The last factor is population density: the total number of deaths and injuries is likely to be much higher in densely populated areas.

There are large variations within disaster-affected areas. Mortality of up to 85% occasionally may occur close to the epicenter of the earthquake. The ratio of dead to injured decreases as the distance from the epicenter increases.

Some age groups are more affected than others; fit adults are spared more than small children and the elderly, who are less able to protect themselves. However, 72% of the deaths resulting from collapsed buildings in the 1985 Mexico earthquake were among persons between the ages of 15 and 64 (see Table 1.2).

Secondary disasters may occur after earthquakes and increase the number of casualties requiring medical attention. Historically, the greatest risk is from fire, although in recent decades, post-earthquake fires causing mass casualties have been uncommon. However, in the aftermath of the earthquake that hit Kobe, Japan, in 1995, over 150 fires occurred. Some 500 deaths were attributed to fires, and approximately 6,900 structures were damaged. Fire-fighting efforts were hindered because streets were blocked by collapsed buildings and debris, and the water system was severely damaged.

Little information is available about the kinds of injuries resulting from earthquakes, but regardless of the number of casualties, the broad pattern of injury is likely to be a mass of injured with minor cuts and bruises, a smaller group suffering from simple fractures, and a minority with serious multiple fractures or internal injuries requiring surgery and other intensive treatment. For example, after the 1985 earthquake in Mexico, 1,879 (14.9%) of the 12,605 patients treated by the emergency medical services (including certain routine cases) needed hospitalization, most of them for a 24-hour period.

Most of the demand for health services occurs within the first 24 hours of an event. Injured persons may continue to show up at medical facilities only during the first three to five days, after which presentation patterns return almost to nor-

**TABLE 1.2. Distribution of deaths by age group resulting from the September 1985 earthquake in Mexico City.<sup>a</sup>**

Age group (years)	Deaths	Percent of deaths
Under 1 year old	173	4.8
1 – 4	143	4.0
5 – 14	287	8.0
15 – 24	770	21.5
25 – 44	1,293	36.1
45 – 64	519	14.5
65 and older	226	6.3
Not defined	168	4.7
Total	3,579	100

<sup>a</sup>Bodies recovered from collapsed buildings between 19 September and 29 October 1985.

**Source:** General Directorate of Investigation, Attorney General, Department of Justice, Mexico, D.F.

mal. A good example of the crucial importance of the timing of emergency care is seen in the number of admissions to a field hospital after the 1976 earthquake in Guatemala, as shown in Figure 1.1. From day six onward, admissions fell dramatically, despite intensive case-finding in remote rural areas.

Patients may appear in two waves, the first consisting of casualties from the immediate area around the medical facility and the second of referrals as humanitarian operations in more distant areas become organized.

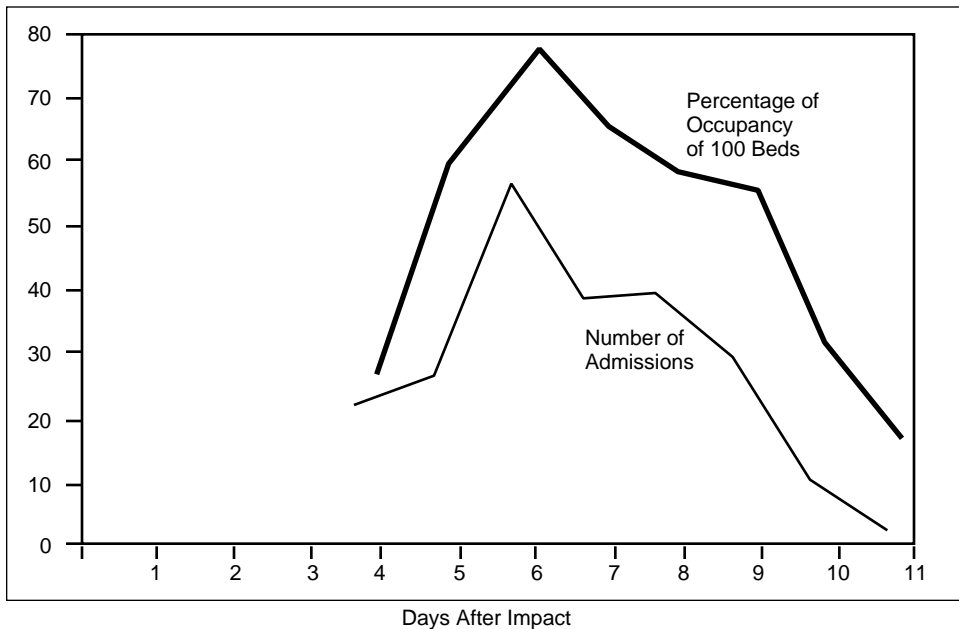
### Destructive Winds

Unless they are complicated by secondary disasters such as the floods or sea surges often associated with them, destructive winds cause relatively few deaths and injuries. Effective warning before such windstorms will limit morbidity and mortality, and most injuries will be relatively minor. Most of the public health consequences from hurricanes and tropical storms result from torrential rains and floods, rather than wind damage. The catastrophic death toll—an estimated 10,000—in Central American countries after Hurricane Mitch in 1998 was primarily caused by flooding and mudslides.

### Flash Floods, Sea Surges, and Tsunamis

These phenomena may cause many deaths, but leave relatively few severely injured in their wake. Deaths result mainly from drowning and are most common among the weakest members of the population. More than 50% of the deaths in

**FIGURE 1.1.** Admissions and occupancy rates at the field hospital in Chimaltenango, Guatemala, 1976.



Nicaragua following Hurricane Mitch in 1998 were due to flash floods and mudslides on the slopes of the Casitas Volcano.

## **Volcanoes**

Volcanoes are found worldwide and significant numbers of people often live in close proximity to them. The fertile volcanic soil is good for agriculture and is attractive for the establishment of towns and villages. In addition, volcanoes have long periods of inactivity, and some generations have no experience with volcanic eruptions, thereby encouraging the population to feel some degree of security in spite of the danger in living close to a volcano. The difficulty in predicting a volcanic eruption compounds the situation.

Volcanic eruptions affect the population and infrastructure in many ways. Immediate trauma injuries may be caused if there is contact with volcanic material. The super-heated ash, gases, rocks, and magma can cause burns severe enough to kill immediately. Falling rocks and boulders also can result in broken bones and other crush-type injuries. Breathing the gases and fumes can cause respiratory distress.

Health facilities and other infrastructure can be destroyed in minutes if they lie in the path of pyroclastic flows and lahars (mudflows containing volcanic debris). Accumulated ash on roofs can greatly increase the risk of collapse. Contamination of the environment (e.g., water and food) with volcanic ash also can disrupt environmental health conditions; this effect is compounded when the population must be evacuated and housed in temporary shelters.

If the eruptive phase is prolonged, as in the case on the Caribbean island of Montserrat where the Soufriere Hills volcano began erupting in July 1995 and continued for several years, other health effects, such as increased stress and anxiety in the remaining population, become important. Long-term inhalation of silica-rich ash also can result in pulmonary silicosis years later.

One of the most devastating events to occur in Latin America was the November 1985 eruption of the Nevado del Ruiz volcano in Colombia. The heat and seismic forces melted a portion of the icecap on the volcano, resulting in an extensive lahar that buried the city of Armero, killing 23,000 people and injuring 1,224. Some 1,000 km<sup>2</sup> of prime agricultural land at the base of the volcano were affected.

## **Floods**

Slow-onset flooding causes limited immediate morbidity and mortality. A slight increase in deaths from venomous snakebites has been reported, but not fully substantiated. Traumatic injuries caused by flooding are few and require only limited medical attention. While flooding may not result in an increased frequency of disease, it does have the potential to spark communicable disease outbreaks because of the interruption of basic public health services and the overall deterioration of living conditions. This is of concern particularly when flooding is prolonged, as in the case of events caused by the El Niño phenomenon in 1997 and 1998.

## Landslides

Landslides have become an increasingly common disaster in Latin America and the Caribbean; intense deforestation, soil erosion, and construction of human settlements in landslide-prone areas have resulted in catastrophic events in recent years. This has been the case in both urban and rural areas. Rain brought by Tropical Storm Bret triggered landslides in poor neighborhoods on the outskirts of Caracas, Venezuela, in August 1993. At least 100 people died, and 5,000 were left homeless. High death tolls occurred in the gold mining town of Llipi, Bolivia, in 1992, where a landslide buried the entire village, killing 49. Deforestation contributed significantly to the disaster, and mining tunnels collapsed. A similar disaster occurred in the gold mining region of Nambija, Ecuador, in 1993, claiming 140 lives.

In general, this phenomenon causes high mortality, although injuries are few. If there are health structures (hospitals, health centers, water systems) in the path of the landslide, they can be severely damaged or destroyed.

## 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:

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| <i>Myth:</i>    | Foreign medical volunteers with any kind of medical background are needed.   |
| <i>Reality:</i> | The local population almost always covers immediate lifesaving needs. Only medical personnel with skills that are not available in the affected country may be needed.   |
| <i>Myth:</i>    | Any kind of international assistance is needed, and it's needed immediately!   |
| <i>Reality:</i> | 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 foreign intervenors. |
| <i>Myth:</i>    | Epidemics and plagues are inevitable after every disaster.   |
| <i>Reality:</i> | 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.  |
| <i>Myth:</i>    | Disasters bring out the worst in human behavior (e.g., looting, rioting).  |
| <i>Reality:</i> | Although isolated cases of antisocial behavior exist, most people respond spontaneously and generously.  |
| <i>Myth:</i>    | The affected population is too shocked and helpless to take responsibility for their own survival.   |
| <i>Reality:</i> | 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—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 country.

*Myth:* Things are back to normal within a few weeks.

*Reality:* The effects of a disaster last a long time. Disaster-affected countries deplete much of their financial and material resources in the immediate post-impact phase. Successful relief programs gear their operations to the fact that international interest wanes as needs and shortages become more pressing.