



M O D U L E I

Disasters and their Effects on Children: Key Concepts

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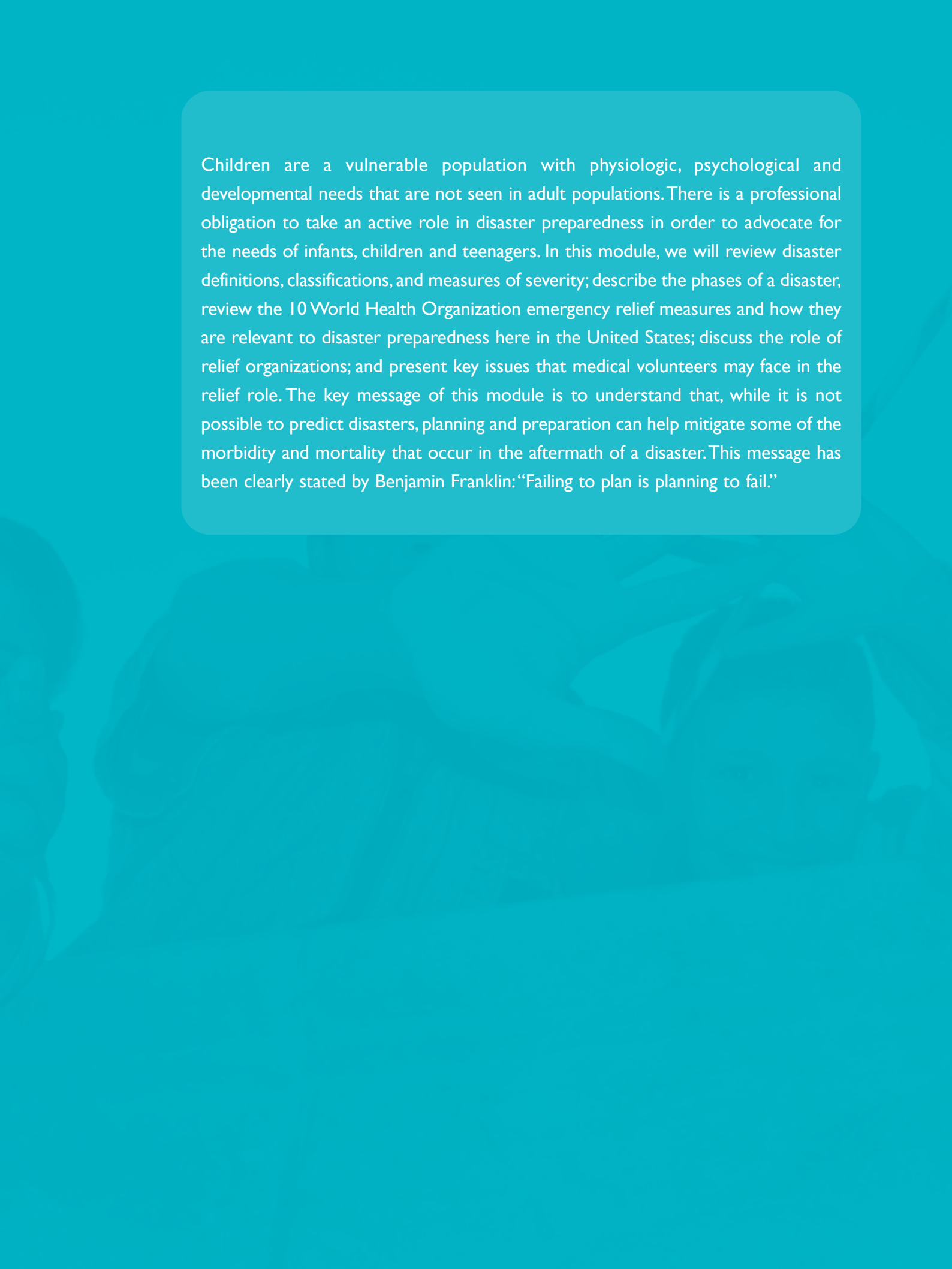
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INTRODUCTION

The recent advances in technology and the ease with which news and information travel around the world has made learning about disasters in far off countries an almost weekly occurrence. From the recent earthquakes in Haiti and China, to the severe flooding in Pakistan and the deadly Asian tsunami, these disasters have lead to unimaginable levels of destruction and death. Although most of these disasters occur in underserved areas in the world without the resources and technology, they can also occur in societies with advanced medical systems such as the United States. Events such as those on September 11th and Hurricane Katrina should serve as reminders that we are just as vulnerable to the forces of nature and man-made disasters as other parts of the world. It is impossible to predict when and where the next disaster will take place. However, we can strive to be prepared to handle both the acute and longer-term effects of a variety of disasters in different populations. While the timing and the actual disaster event are difficult to predict, there are several consequences of disasters that are predictable and thus we can be prepared to deal with these consequences. In the years after the events of September 11th, a great deal of money has been spent on disaster preparedness. As pediatricians, we must ensure that disaster preparedness includes the unique needs of children.

A group of diverse children, including a girl with braids, a boy with a headband, and a girl with a headscarf, are sitting together and looking towards the camera. They are all smiling and appear to be in a classroom or community setting.

Children are a vulnerable population with physiologic, psychological and developmental needs that are not seen in adult populations. There is a professional obligation to take an active role in disaster preparedness in order to advocate for the needs of infants, children and teenagers. In this module, we will review disaster definitions, classifications, and measures of severity; describe the phases of a disaster; review the 10 World Health Organization emergency relief measures and how they are relevant to disaster preparedness here in the United States; discuss the role of relief organizations; and present key issues that medical volunteers may face in the relief role. The key message of this module is to understand that, while it is not possible to predict disasters, planning and preparation can help mitigate some of the morbidity and mortality that occur in the aftermath of a disaster. This message has been clearly stated by Benjamin Franklin: “Failing to plan is planning to fail.”

DEFINITIONS

OBJECTIVES

- Recognize events that can lead to disasters and humanitarian emergencies.
- Understand the individual and social factors associated to vulnerability and adverse outcomes.

Definitions

What makes an event a disaster? Why is one tornado a disaster and the next one, even with stronger winds, is just a bad storm? The answer lies with how the population is affected: both the direct effects on the people as well as the indirect effects or damage to infrastructure. The World Health Organization and the Pan American Health Organization (WHO/PAHO) define a disaster as an event that most often occurs suddenly and unexpectedly, resulting in loss of life, harm to the health of the population, destruction of community property, and damage to the environment. A disaster disrupts the normal pattern of life, causing both physical and emotional suffering and an overwhelming sense of helplessness and hopelessness. The impact on the socioeconomic structure of a region and environment often requires outside assistance and intervention. Although there

are many definitions for disaster, there are three common factors.

First, there is an event or phenomenon that impacts a population or an environment.

Second, a vulnerable condition or characteristic allows the event to have a more serious impact. For example, a tornado will cause much greater damage to life and structures if it directly strikes a mobile home park compared to striking a community of well-built homes with greater structural support. During the Hurricane Katrina disaster, the combination of a category 5 hurricane, a failing levee system, and a poor preparation for a disaster response resulted in much of the morbidity and mortality seen in the city of New Orleans. Identifying these factors has practical implications for communities' preparedness and provides a basis for prevention.

Third, local resources are often inadequate to cope with the problems created by the phenomenon or event.

Disasters affect communities in multiple ways. Their impact on the health care infrastructure is also multi-factorial. The disaster event can cause an unexpected number of deaths. In addition, the large numbers of wounded and sick often exceed the local community's health care delivery capacity. The community's capacity to care for those affected is often reduced



Any adverse episode or phenomenon can exploit a vulnerability in the affected population or community to create damage, and this awareness will form the basis for an adequate intervention.

because professionals, clinics and hospitals have been affected or destroyed. This will have long-term consequences leading to increased morbidity and mortality. An example of this can be seen in the 2010 Haiti earthquake disaster. Prior to the January 12, 2010 earthquake in Haiti there were only 11 hospitals in Port-au-Prince. The earthquake damaged or destroyed at least eight of these hospitals. The remaining health facilities were quickly overwhelmed by large numbers of survivors requiring a wide range of care, particularly for traumatic injuries. The 2010 earthquake in Haiti demonstrates how a disaster becomes much more devastating when the pre-existing medical system is already inadequate and poorly functional. This makes integrating and organizing outside assistance more fragmented and chaotic. An epidemic/pandemic can cause a surge in the number of people seeking medical care/treatment and thus overwhelm the abilities of even a well established medical system. The 2009 H1N1 pandemic stressed the emergency medical services and hospitals throughout the world.

The disaster can have adverse effects on the environment that will increase the risk for infectious transmissible diseases and environmental hazards. The loss of clean drinking water and proper sewage disposal/treatment can have devastating effects on a population affected in the disaster. This will impact morbidity, premature death, and future quality of life. There can be shortages of food, with severe nutritional consequences. All these conditions lead to a sense of hopelessness, vulnerability, and inability to think that the future will be better. This

means that people no longer visualize their future by making plans such as finishing school, getting married and working. This “foreshortened future” affects the psychological and social behavior of the community.

Classification of Disasters

Disasters can be divided into those caused by natural forces and those caused by man, as shown in **Table I**.

Disasters can be divided into 2 large categories: those caused by natural forces and those caused by man.

TABLE I. Types of disasters

Natural disasters

- Hurricanes or cyclones
- Tornadoes
- Floods
- Avalanches and mud slides
- Tsunamis
- Hailstorms
- Droughts
- Forest fires
- Earthquakes
- Epidemics

Man-provoked disasters

Technological/industrial disasters

- Leaks of hazardous materials
- Accidental explosions
- Bridge or road collapses, or vehicle collisions
- Power cuts

Terrorism/International violence

- Bombs or explosions
- Release of chemical materials
- Release of biological agents
- Release of radioactive agents
- Multiple or massive shootings
- Mutinies
- Intentional fires

Complex emergencies

- Conflicts or wars
- Genocide

Natural forces include earthquakes, tsunamis, volcanic eruptions, hurricanes, fires, tornados, pandemics, and extreme weather conditions. They can be classified as rapid onset disasters such as earthquakes or tornados, and those with progressive onset, such as droughts that lead to famine. Natural events, usually sudden, can have tremendous effects, for instance, a major earthquake that struck the San Francisco Bay Area of California on October 17, 1989, 6.9 on the open-ended Richter Scale. The quake killed 63 people throughout northern California, injured 3,757 and left over 8,000 people homeless.

Naturally occurring disasters also have predictable patterns of disruption based on the degree of severity, local features and type of response, **Table 2**.

Disasters caused by man are those in which major direct causes are identifiable; these can result from intentional or non-intentional human actions. They can be subdivided into three main categories: technological disasters, terrorism and complex humanitarian emergencies.

Technological disasters are most often industrial events resulting from unregulated industrialization and inadequate safety standards. Examples include the radioactive leak in the Chernobyl nuclear station in Ukraine (1986) and the toxic gas leak in a Bhopal factory in India (1984). Both of these disasters were associated with many deaths as well as long-term health effects in the affected population. In the United States, the 1979 melt-down at the Three Mile Island nuclear plant in

TABLE 2. Frequent effects of disasters

Disaster type Effect	Complex emergency	Earthquake	Strong winds	Floods	Gradual floods	Mud slides	Volcanic eruptions
Immediate deaths	Numerous	Numerous	Few	Numerous	Few	Numerous	Numerous
Severe lesions	Numerous	Numerous	Moderate	Few	Few	Few	Few
Increased risk for transmissible diseases	This risk applies to ALL significant disasters, and increases with overcrowding and deterioration of sanitary conditions						
Damage to health centers	Moderate; can be severe if health centers are military targets	Severe	Severe	Severe but localized	Severe (only for equipments)	Severe but localized	Severe
Damage to water supply	Severe	Severe	Slight	Severe	Slight	Severe but localized	Severe
Food shortage	Severe	May result from economic and logistic factors		Frequent	Frequent	Not frequent	Not frequent
Significant population displacements	Frequent	Frequent; increased likelihood in severely damaged urban areas	Not frequent	Frequent			

Adapted from: *Humanitarian Assistance in disaster situations. A Guide for effective aid*. Pan-American Health Organization (PAHO). Washington D.C, 1999.

Pennsylvania could have resulted in a large scale release of radioactive material that would have had devastating effects on the surrounding area. The events of September 11th and the 1995 bombing of the Alfred P. Murrah Federal Building in downtown Oklahoma City as examples of US terrorist caused disaster events. The threat of terrorism has increased due to the spread of technologies involving nuclear, biological, and chemical agents as well as the use of explosives and firearms. Explosive or blast events are the most common type of terrorist event causing morbidity and mortality. The term “complex humanitarian emergency” describes the situation resulting from either an international or civil war. War often results in a staggering loss of civilian lives. There is a disruption of the basic societal infrastructure including food distribution, water, electricity, sanitation, and health care. In addition, the ability to carry out an emergency relief response is hindered by a lack of security as well as political instability. While this type of disaster is not thought of as a likely threat here in the United States, similar disruptions in the ability to provide basic infrastructure can occur, such as seen in the days following Hurricane Katrina, where flood waters and security threats were the obstacles in providing emergency relief.

Both natural disasters and complex emergencies can force many people to leave their homes due to their homes having either been directly or indirectly damaged by the disaster event. Fire or wind damage are two ways in which homes can be directly damaged and thus

left uninhabitable. A disaster event can indirectly affect a home by causing a lack of electricity and safe water, thus leading to many individuals and families being displaced. During the evacuation of New Orleans, as a result of Hurricane Katrina, 800,000 citizens were forced to live outside of their homes – the largest displacement of people since the great Dust Bowl migrations of the 1930s (citation: Department of Homeland security web site, http://www.dhs.gov/xfoia/archives/gc_1157649340100.shtm) . These internally displaced persons (IDP) are refugees that do not cross international boundaries. The arrangement for many of these displaced persons was carried out by combination of individuals, local and federal government organizations (FEMA) and nongovernmental organizations (American Red Cross). A smaller but more local example would include the front range fire in Boulder Colorado, September 2010, where thousands of individuals and families were displaced from their homes.

Phases of Disaster Relief

Since relief interventions in emergencies evolve as a continuum, it is useful to prioritize activities and resources according to four phases: planning, response, recovery, and mitigation/prevention.

Planning comprises all the activities and actions taken before a disaster has occurred. The first step in disaster relief planning is to do an analysis of the community’s or organization’s risk for exposure to specific types of disasters. Areas in the Midwestern part of the country



should anticipate and plan for tornadoes but do not need to plan for a disaster caused by a hurricane. Much in the same way coastal regions along the Gulf of Mexico and the Atlantic ocean should ready themselves for effects of severe hurricanes, but do not need to plan for major earthquakes. In today's environment of political and religious extremism, all areas must consider themselves at some risk for a terrorist attack from either hostile international groups (e.g., the events of 9/11) or home-grown extremist (e.g., the 1995 bombing of the Alfred P. Murrah Federal Building in downtown Oklahoma City). Plans should take into account the frequency of occurrence of each type of disaster, the anticipated magnitude of effect, and the likelihood that there will be an advanced warning. The U.S. Department of Homeland Security has developed 15 all-hazards planning scenarios for use in national, federal, state, tribal, and local homeland security preparedness activities. These are: 1. Improvised nuclear device, 2. Aerosol anthrax, 3. Pandemic influenza, 4. Plague, 5. Blister agent, 6. Toxic industrial chemicals, 7. Nerve agent, 8. Chlorine tank explosion, 9. Major earthquake, 10. Major hurricane, 11. Radiological dispersal device, 12. Improvised explosive device, 13. Food contamination, 14. Foreign animal disease, 15. Cyber attack (citation: State Of Colorado Homeland Security Strategy 2008-2013). (See the table of likely disasters in Colorado.)

The analysis should also consider the characteristics of the populations most likely to be affected, the amount and types

of resources available within the community or organizational structure, and the ability to function independently without additional outside resources for periods of time.

Planning phase should also consider notification systems that may be used to warn the population about an imminent disaster. The Emergency Alert System (EAS) is a nationwide method of alerting the public to natural and manmade disasters. The Federal Communications Commission (FCC) regulations require all broadcast stations (television and radio) and cable systems to participate in EAS tests and activations. EAS is the fastest and most reliable way to alert large areas or isolated locations of potential life-threatening emergencies.

The response phase includes all activities and actions taken during and immediately after a disaster. This includes notification of the organizations involved in disaster response, setting up of initial communication networks, initial search and rescue, triaging and treating the critically injured, disposal of the dead, damage assessment, evacuation, sheltering and other multiple activities.

The response phase is characterized by initial chaos, high crude mortality rate (CMR) and, hopefully, rapid assessments of the situation by specialized response teams. The response phase is often complicated by the lack of functional communications and central organization. The response phase lasts until the initial casualties have either been rescued or acknowledged as lost, and enough resources have been made available to

allow the population to assess damages and begin planning restoration and recovery. This phase can last hours to weeks. During the first few days following a disaster, local communities must usually rely on their own resources and disaster plans.

The recovery phase is the period in which the affected organization or community works toward re-establishing self-sufficiency. This is the period of new community planning, rebuilding, and re-establishment of government and public service infrastructure. The health status of affected population begins to return to pre-disaster conditions and the outside support services are gradually withdrawn.

During the mitigation and prevention phase all aspects of emergency management are scrutinized for “lessons learned,” and the lessons are then applied in an effort to prevent the recurrence of the disaster itself or to lessen the effects of subsequent events. Mitigation includes preventive and precautionary measures such as changing building codes and practices, redesigning public utilities and services, reviewing mandatory evacuation practices and warning policies, and educating members of the community. Mitigation and planning are continuous processes, as lessons learned from a previous disaster are included in planning for the next one.

Major Colorado Disasters

Colorado has been hit with disasters in the past that have killed hundreds, required evacuations and resulted in having certain areas of the state being declared Federal Disaster Areas. In the past 10 years, a number of Colorado disasters have caused millions of dollars in damage. Other hazards, such as tornadoes or winter storms, have threatened lives or caused property damage.

Winter Hazards

- Colorado leads the nation in the number of avalanche deaths every year
- 8-9 people are killed each year in avalanches
- 77 deaths were caused by winter weather in 1998
- 51 deaths were caused by extreme cold in 1997

March 2003 Blizzard

- Denver received 31.5 inches of snow in two days
- Rocky Mountains received as much as 87 inches in various places
- Parts of I-25, I-70 and I-76 all closed
- Denver International Airport closed
- Residents trapped at home for 3 days
- Colorado National Guard sent 21 humvees to rescue stranded motorists
- Snow Emergency declared by Governor
- Insurance industry estimates \$93 million in damage; worst winter storm in state history
- Power lost for 2-3 days in portions of metro Denver and in other Front Range cities and towns



Major Colorado Disasters (cont.)

Floods

- 64 Colorado counties have flood-prone areas
- 250,000 people live in areas designated as flood plains
- 15,000 commercial structures in flood plain areas
- More than 330 killed in floods between 1900-1993

Big Thompson Canyon Flood – July, 1976

- Worst flood in Colorado history
- More than 140 people killed
- 418 homes destroyed
- 52 businesses destroyed
- \$35.5 million in damage

South Platte River Flood – June, 1965

- 6 people killed
- 26 bridges destroyed
- More than 1000 buildings destroyed in metro Denver
- 600+ homes destroyed in City and County of Denver
- Phone service disrupted for 8,000 customers

Fires

- Worst wildfire season in state history in 2002
- More than 3,000 separate fires
- More than 600,000 acres burned
- Nearly 400 homes and 620 outbuildings destroyed
- Insurance costs totaled nearly \$80 million dollars.
- Affected counties declared National Disaster Areas

Hayman Fire – June 2002

- Largest wildfire ever to hit Colorado
- Burned for 3 weeks
- More than 138,000 acres burned
- More than 130 homes destroyed
- Hundreds evacuated
- Property losses totaled nearly \$30 million

- Colorado averages 40 tornadoes a year
- Colorado ranks 9th in the nation in number of tornadoes each year
- June 1990 Limon tornado caused \$12 million in damage
- Winds can reach up to 200 mph in a tornado
- May-July are most dangerous months, but tornadoes have been reported during 9 months of the year
- Tornadoes hit mainly in the afternoon to early evening

Major Colorado Disasters *(cont.)***Tornadoes**

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Statistics from Colorado Division of Emergency Management, Insurance Institute, FEMA, Weather and Climate Assessment Program, <http://www.readycolorado.com/pdf/coloradodisasters.pdf>

MORTALITY

OBJECTIVES

- Recognize crude mortality rate as a measure of disaster severity.
- Recognize the environmental factors associated with increased morbidity and mortality rates.
- Know the 5 leading causes of death in humanitarian emergencies occurring in developing countries.

Severity of a Disaster

As was demonstrated in Haiti, the more fragile the pre-event health status of the affected population and inadequate the pre-disaster infrastructure, the more severe the disaster. Disaster severity will, therefore, vary according to its magnitude and the vulnerability of the population. An example of this is seen in earthquakes of similar magnitude in different parts of the world. Earthquakes in China and Haiti resulted in a large number of collapsed buildings including schools and hospitals related to substandard building practices in both, and thus high

number of casualties. The damage from similar magnitude occurring in Tokyo in 2009 and Chile in 2010 resulted in far less loss of life in large part due to the higher quality of construction and stricter building codes. When assessing the outcome of a disaster, public health officers describe its severity by the number of human lives lost using the crude mortality rate (CMR). CMR is usually defined as the number of deaths per 10,000 inhabitants per day. In developing nations, the reference CMR value varies from 0.4 to 0.7 deaths per 10,000 people/day. A CMR above 1 death per 10,000 people/day is considered a humanitarian emergency. To assess the progression of a disaster and the effectiveness of relief interventions, measure the CMR over several appropriate time intervals. For example, during the month following the massive movement of Rwandan refugees to Eastern Zaire, the CMR in that region was 40 to 60 times above the corresponding reference value. The CMR is usually highest during the initial phase of a disaster; **Table 3**.



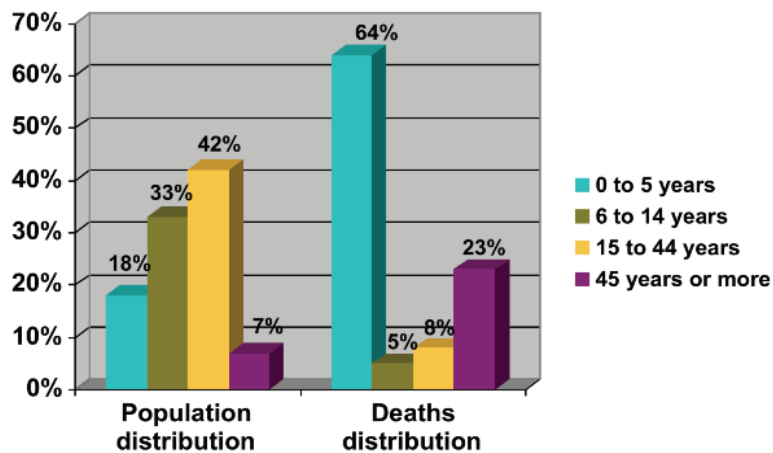
Most diseases associated with the event can be prevented by adequate interventions, especially ensuring basic sanitation.

TABLE 3. Crude mortality rate: Baseline and after humanitarian disaster

Date	Origin	Host Country	CMR Crisis	CMR Baseline
1991	Somalia	Ethiopia	4.7	0.6
1991	Iraq	Turkey/Iraq	4.2	0.2
1994	Rwanda	Zaire	34.0	0.6

Adapted from Toole MJ. Mass Population Displacement – A Global Public Health Challenge. *Infectious Disease Clinics of North America*, Volume 9; 1995

FIGURE I. Mortality rate among per age group: refugee crisis in Northern Iraq (1991)



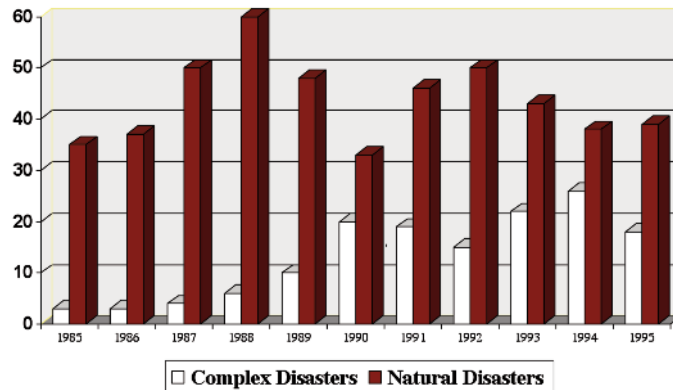
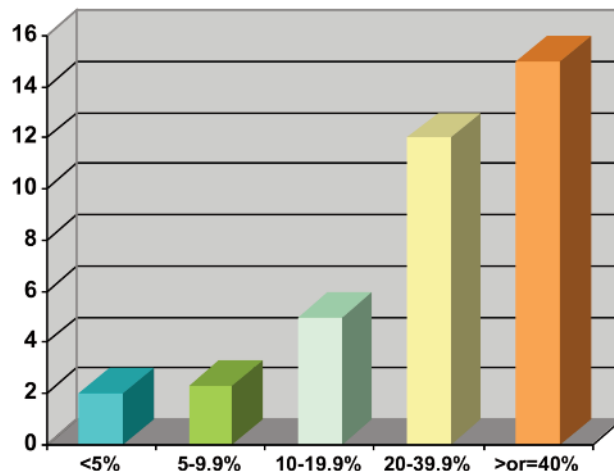
Adapted from: Toole MJ. Mass Population Displacement — A Global Public Health Challenge. *Infectious Disease Clinics of North America*, 1995;9(2):353-66.

The immediate mortality in most disasters is not higher in a specific age range; instead, it usually reflects the age distribution of the overall population. However, later, the mortality rate is disproportionately higher among the youngest and oldest people. **Figure I** shows this phenomenon related to a refugee crisis in Northern Iraq in 1991. Although children aged 0 to 5 years accounted for only 18% of the total refugee population, they accounted for 64% of the overall refugee mortality rate.

The most vulnerable groups include children, especially those displaced from their families, women who are pregnant, lactating, or live without their spouse; individuals living in households headed only by women; disabled individuals; and the elderly. In addition to disproportionately high mortality rates, children displaced from their family are at high risk for a number of adverse consequences, including rape, rob-

bery and exploitation. Additionally, because of certain physical and physiological characteristics (such as a higher surface area to total body mass ratio), infants and children are more vulnerable to the release of toxic substances and the overcrowding associated with the displacement of large populations. Consequently, in all disaster response planning, it is critical to attempt to reunite children with their families as soon as possible and pay special attention to reducing their vulnerability.

Trauma is often the leading cause of mortality from the immediate impact of a disaster. After the initial impact phase, there are five leading medical problems that have consistently been found to be the major causes of mortality in post-war or post-natural disaster settings: diarrhea and dehydration, measles, malaria, respiratory infections, and malnutrition. Unique features in each disaster (eg, climate,

FIGURE 2. Number of natural and complex disasters worldwide, 1985-1995**FIGURE 3.** Effects of malnutrition on mortality rates during disasters

Adapted from: Toole MJ. Mass Population Displacement — A Global Public Health Challenge. *Infectious Disease Clinics of North America*, 1995;9(2):353-66

topography, pre-existing social and medical structure, and physical conditions) affect the proportion of deaths associated with each of these, as well as other causes. **Figure 2** shows the number of natural and complex disasters in the world between 1985 and 1995. Malnutrition, although not identified as a significant

immediate cause of death, is the most important factor correlated to the high mortality rates due to transmissible diseases. A study including 41 displaced populations (**Figure 3**) showed a clear correlation between the crude mortality rate (i.e., death from all causes) and the prevalence of malnutrition.



SECTION III / ESSENTIAL EMERGENCY RELIEF MEASURES

ESSENTIAL EMERGENCY RELIEF MEASURES

OBJECTIVES

- Understand the 10 essential emergency relief measures (as defined by WHO).
- Know how these measures should be implemented in the community.

At a World Health Organization conference, international relief experts identified 10 essential emergency relief measures to consider when responding to a disaster. These interventions are not intended to be implemented in strict order; rather priority for each intervention should be suited to the particular needs relating to each individual emergency situation. The immediate goal for any intervention in humanitarian emergencies is to reduce the number of deaths. While both conflict and natural disasters can result in immediate deaths, there are many preventable deaths that occur in later phases of a disaster over a longer time period. Interventions that are based on speculations rather than on accurate information obtained in the place of the disaster are likely to waste time and valuable resources, ultimately increasing the suffering of the affected population. Unpredicted effects may require urgent attention. For example,

compromise of a water supply system is unlikely to be a predicted effect of storm related mudslide. However, if the regional system for water pumping or purification is in the mudslide zone, the shortage of safe water becomes the key issue that must be addressed to prevent disease and excessive mortality in the affected population. Resources need to match both the need and the timeframe to be useful. For example, trauma is likely to be the major cause of death immediately after an earthquake. If trauma surgery teams and field hospitals arrive a week after the earthquake, most of the trauma-related deaths will already have occurred and very little benefit will be obtained from this high-cost resource.

I. Do a rapid assessment of the emergency situation and the affected population

An assessment should accurately define what is needed, so that limited resources will be efficiently used to minimize morbidity and mortality as well as reduce the likelihood of additional problems/complications during subsequent phases of response.

State/National Level: Assessments are typically done by expert teams focused on promptly defining the event magnitude,

the environmental conditions and infrastructure damage, the major health and nutrition needs of the affected population, and the local response capacity.

Community Level: In the immediate aftermath of a disaster, the initial response will primarily come from local resources. Communities must be prepared to do a local assessment of disaster impact. The local community should identify who is qualified to assist in the immediate aftermath of a disaster and their role should be defined in the disaster planning phase prior to the disaster event. Health care professionals should be prepared to assess the health issues in their community, and understand how information will be shared with higher levels of authority, in order to contribute to regional or national assessments.

Assessments need to be an ongoing process so that the quality and specificity of data will improve during the rescue and recovery phases. This is especially important whenever any major change occurs, such as an aftershock earthquake. Information gathered through these assessments should be used by the resource managers to determine the allocation of resources in any large-scale disaster.

2. Provide adequate shelter and clothing

Shelter and clothing is essential as exposure to the climatic conditions in disaster situations can increase caloric requirements and lead to death.

Community Level: Find short-term shelters for all homeless individuals, particularly focusing on vulnerable populations. The

American Red Cross and other non-governmental agencies are often involved in this process. Shelters should be appropriate for the climate and focus on providing a safe environment from subsequent events related to the disaster. After an earthquake, shelters should be established in locations that would not have potential for further damage from collapsing buildings or falling debris from anticipated aftershocks. During times of flooding, it is important that shelter for the displaced individuals is located in an area that is not at risk of rising flood waters. Displaced victims will not use these shelters if they do not feel safe. Keep individuals within their communities and family networks as much as possible. In general, it is recommended to direct resources to rebuilding within the community, rather than building large camps or temporary settlements outside the disaster area. Schools are often used as emergency shelters following a disaster. However, it is important for children to return to as normal a routine as possible as early as possible. This means that schools should be reopened as soon as possible and teachers should be trained to understand stress reactions and recognize when additional help is needed.

State/National Level: Governmental agencies such as FEMA are often involved in establishing housing for displaced populations as they did with many of the people whose homes were destroyed in Hurricane Katrina. The national government can also release funds to help families repair or rebuild their homes as part of the recovery phase of the disaster response.



Large-scale bulk food requirements are typically calculated based on a minimum of 2,000 kcal/person/day.

3. Provide adequate nutrition

Large-scale bulk food requirements are typically calculated based on a minimum of 2,000 kcal/person/day.

Community Level: Communities must plan to distribute food equitably and include vulnerable groups, such as young children and pregnant and breastfeeding women.

4. Provide elementary sanitation and clean water

The estimated minimum requirement for water is 3 to 5 L/person/day of clean water. Flooding often results in disruption to the sewage treatment and water filtration process that provides safe, clean water to the affected community.

Community Level: Re-establish supplies of clean water and effective sanitation and waste disposal services as soon as possible. Consider how to address the needs of vulnerable groups related to access, safety, and security in the planning process. Providing safe drinking water should be established as soon as it is noted that there has been a breach in the clean water supply system of the affected area.

5. Set up diarrhea control program

In many disasters in developing countries, a great deal of mortality and morbidity is caused by diarrheal diseases. The combination of diarrheal illness, with overcrowding, poor sanitation, and lack of clean drinking water, as happened following Katrina, leads to rapid transmission of the diarrheal illness and dehydration among the displaced population. An increase in

diarrheal disease is a predictable outcome of disasters because of infrastructure and health care services disruption.

Community Level: Rapidly implement community-based education on appropriate household sanitation measures, diarrhea prevention, and household case management, particularly for young children with diarrhea. Health care centers should anticipate the needs for additional cases of dehydration, using appropriate low-cost strategies (ORS / ORT) and recognize possible cases of cholera and dysentery.

6. Immunize against measles and provide vitamin A supplements

In the aftermath of many disasters in countries with poor pre-event medical structures, measles has been a major source of mortality among crowded, displaced populations in which malnutrition is prevalent. Therefore, measles immunization is the only vaccine that is routinely considered for use as a preventive measure immediately following a disaster. When vitamin A deficiency is common, consider mass distribution of vitamin A for vulnerable populations since it contributes to measles-related mortality. To prevent measles outbreaks, scientists estimate 95 percent of the population must be immune. In the United States, vaccination rates are at record levels: Coverage exceeded 90 percent for children roughly 1 1/2-3 years old and 95 percent for children ages 5-6 years. It must be noted, that there are regions of much lower immunization rates in different parts of the

country. In Chicago, coverage for children in a 1994 study was 47 percent overall but only 29 percent for inner-city, African-American children. Another study of young children in rural New York found that only 85 percent were vaccinated. According to the Centers for Disease Control and Prevention (CDC), just over one-half of all schoolchildren in the United States have had both doses of the vaccine. This is important because one dose is only 95 percent effective. (Ninety-five percent of people with one dose will gain immunity; the other 5 percent will fail to develop antibodies and will be unprotected.) Even when both doses are given, some people fail to form antibodies, although the probability of this happening is extremely low. It is important to know the vaccination rate for the affected region, and if needed an immunization program should be established in areas of overcrowding after the disaster event (citation: National Institutes of Health and the National Institute of Allergy and Infectious Diseases website: http://science.education.nih.gov/supplements/nih1/diseases/activities/activity5_measles-database3.htm#28).

National and State Level: National and international agencies must work together to determine if measles immunization or vitamin A distribution is necessary following a particular event. CDC and state health departments should aid in tracking illnesses and help determine the need for initiating an immunization program. If necessary for all or part of the affected population, national authorities should establish the central logistics (e.g., cold chain, per-

sonnel, materials) to manage a mass immunization/distribution campaign.

Local/Community Level: County health records of immunization rates will be essential in determining the risk of measles in the affected area. Local and county health officials must immediately assess the availability of immunizations and cold chain as part of its health care assessment. Health care professionals must monitor for cases of measles and develop a plan for mass immunization and/or mass distribution of vitamin A to the vulnerable groups in their community.

7. Re-establish and improve primary medical care

Immediate casualties (rescue phase) of a sudden impact disaster are likely to include a limited number of trauma victims. In most disasters in fragile communities the larger number of disaster-related deaths (i.e., deaths above the baseline crude mortality rate) will be due to preventable causes of mortality in the weeks and months following the impact. These casualties can largely be prevented by community health education and access to appropriate primary care.

Community Level: Health professionals should know the emergency transport and response systems in their community. Health care interventions during the rescue phase should include minimizing loss of life caused by the direct impact of the event (e.g., trauma, drowning). After the rescue phase, health care resources should be focused on re-establishing and improving the access and quality of primary care, particularly for the most vulnerable groups.

8. Set up disease surveillance and health information systems

Effective health information and disease surveillance systems are necessary to monitor effectiveness of health interventions and reassign priorities. This would be of great importance in disasters that may involve biological, chemical, or nuclear materials being dispersed.

National Level: Health authorities should use available information to define initial priorities in the use of limited resources. They should develop specific surveillance guidelines for each disaster in order to track relevant disease/mortality trends. In the United States, many of these activities will be carried out by the Center for Disease Control and Prevention (CDC). In cases of a pandemic, such as seen in the 2009 H1N1 flu pandemic, the CDC and state health departments were essential in tracking the spread of the H1N1 flu virus, and the morality and morbidity related to its spread.

Community Level: Every health care delivery setting should immediately implement a simple but effective health information collection system based on governmental guidelines. Health care professionals should know how to share this information regularly with regional and/or federal health authorities.

9. Organize human resources

The initial shock of an event can make it difficult for a disaster-affected population to effectively respond in a quick and organized fashion. Having a pre-defined emergency plan with clearly-identified

leaders can help the local community to cope until more external resources arrive.

Community Level: Have an emergency plan and pre-defined community leaders for:

- Conducting rescue operations
- Conducting assessments (e.g., health services, transportation, food, sanitation/water systems)
- Organizing food and water distribution, and the sanitary program
- Health services management
- Establishing and managing an appropriate morgue
- Identification of unaccompanied minors and other extremely vulnerable individuals (e.g., elderly or persons with a disability) and plans for caring for these individuals.

10. Coordinate activities

National Level: In a large-scale disaster there will be many national agencies attempting to assess, develop plans, and establish priorities for funding at national and regional levels. Most effective relief efforts require effective collaboration between many agencies, each bringing their own expertise and experience. However, all of these agencies will ultimately depend on accurate assessments from the affected communities to make appropriate decisions.

Community Level: Develop local emergency plans that link into regional and national plans and agencies. Understand the mechanisms for communicating information (e.g., assessments, surveillance data) during disasters. Build relationships with key individuals within and outside the community before a disaster occurs.

ORGANIZATIONS

OBJECTIVES

- Identify national and international organizations that may respond to a humanitarian emergency in your country.
- Recognize the available resources, strengths, and limitations of these organizations.

Relief Organizations

When local resources are insufficient, assistance from regional, state, or national organizations will be needed. Each involved organization has its own institutional structure and culture, in addition to other features, such as capacity for response, technical and logistic resources, and thematic or regional approach.

Several national agencies may have an established presence in the area prior to the disaster event. In response to the disaster these agencies may retarget their resources in the affected area to play a role in emergency relief. Effective coordination and cooperation among involved organizations are essential but very difficult to achieve in the chaotic situation of a massive emergency. There are two major types of organizations that can get involved in assistance when a disaster occurs: governmental and nongovernmental organizations (NGOs).

Governmental Organizations

FEDERAL GOVERNMENTAL ORGANIZATIONS

Federal Emergency Management Agency (FEMA) is a division of the U.S. Department of Homeland Security (DHS). The mission of FEMA is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.

STATE GOVERNMENTAL ORGANIZATIONS

Every state has a state level agency for disaster that should work with federal and local agencies in disaster preparedness and response (<http://www.fema.gov/about/contact/statedr.shtm>). In Colorado, there is the Colorado Division of Emergency Management, Department of Local Affairs (www.coemergency.com).

Military help: Both the National Guard and other branches of the United States Military can be mobilized to assist in the response to natural disasters or complex emergencies. Certain unique features make military organizations useful in a disaster.

Advantages

Speed: Few organizations are capable of implementing a large logistic response as rapidly as the military.

Security: The military can secure a specified environment, population, and material.

Transportation: Their fleet of planes and helicopters, as well as land and naval equipments, enable them to transport resources readily.

Logistics: They have experience in maintaining supply lines in problematic environments and situations.

Command, Control, and Communication: They have a well-defined and responsive organizational structure.

Self-sufficiency in the field: When military arrive to the region where the event has occurred, they are capable of fulfilling the needs of their own personnel.

Specialized units: They often have specifically trained and equipped units. These include engineers who can provide technical assistance and preventive medicine teams capable of rapidly performing epidemiologic evaluations and surveillance, outbreak investigations, vector control, and water purification and treatment.

Field hospitals and capacity for medical evacuation: Hospitals can be helpful in certain circumstances.

Shortcomings

Despite all the advantages mentioned above, the use of the military can have significant shortcomings and limitations in some situations.

Medical care: Field hospitals are designed for the care of soldiers wounded in combat (i.e., for the care of wounds suffered by healthy adults). During a disaster, primary care and preventive interventions for women and children are also major needs.

Logistics: Supplies available in the military response system may not be appropriate

for a disaster in terms of prevailing diseases or types of food.

Cost: Military activities are expensive.

Nongovernmental Organizations

NGOs are nonprofit organizations working on a full-time basis in assistance for appropriate development. Thousands of NGOs, both international and national, are functioning throughout the world. Most NGOs are small agencies focusing on very specific development projects (e.g., providing education, working tools, or training in sustainable development). NGOs have an enhanced ability to provide person-to-person assistance because they are likely to have a pre-disaster relationship with the affected communities and understand the local culture and public health issues. They can also shift easily from disaster relief to development, and are willing to make a long-term commitment to community development and rebuilding.

American Red Cross

This is a hybrid agency: neither private nor controlled by a government. Since its founding in 1881, the American Red Cross has been the nation's premier emergency response organization. As part of a worldwide movement that offers neutral humanitarian care to the victims of war, the American Red Cross distinguishes itself by also aiding victims of devastating natural disasters. Over the years, the organization has expanded its services, always with the aim of preventing and relieving suffering. The American Red Cross has nearly 700 locally supported

TABLE 4. Foreign agencies for disaster assistance

US Aid for International Development - Office for Foreign Disaster Assistance (OFDA)
[www.gov/our work/humanitarian assistance/disaster assistance](http://www.gov/our%20work/humanitarian%20assistance/disaster%20assistance)

Canadian International Development Agency (CIDA)
www.acdi-cida.gc.ca

European Commission Humanitarian Organization (ECHO)
www.acdi-cida.gc.ca

United Kingdom Department for International Development (DFID)
www.dfid.gov.uk

Japan International Cooperation Agency (JICA)
<http://www.jica.go.jp/worldmap/english.html>

chapters and thus are able to respond quickly to help in disaster relief aid. Red Cross disaster relief focuses on meeting people's immediate emergency disaster-caused needs. When a disaster threatens or strikes, the Red Cross provides shelter, food, and health and mental health services to address basic human needs. The Red Cross also takes on the role of supporting emergency workers, handles enquiries from concerned family members outside the disaster area, provides blood and blood products to disaster victims, and helps those affected by disaster to access other available resources.

Coordination of organizations

Coordinating the activities of involved organizations poses a tremendous challenge. Following a natural disaster the government/agencies and military are likely to have operational command.

Medical Volunteering

Following a disaster many pediatricians and other health professionals volunteer for a limited time. During the initial response phase, the greatest pediatric needs include air transport teams, surgical teams (a surgeon, OR nurse, anesthesiologist, and critical care pediatrician), as well as pediatricians with training and experience in emergency medicine and critical care. Volunteers may have to be self sufficient for a period of time in terms of food, water, and shelter. Volunteers should work through an established NGO or governmental agency rather than simply "show up" to help.

Volunteers should be prepared to respond quickly, as the quicker the response teams can provide appropriate care, the more effective they can be at saving lives and limiting morbidity. Part of preparation is anticipating the types of injuries that will be seen with different

types of disasters. When sending a response team into a disaster during the acute response phase, it is important to have the personnel with the ability to treat the most likely injuries seen with the specific type of disaster. In a major earthquake like the one in Haiti in January 2010, one would expect the majority of the casualties to be secondary to traumatic injuries related to collapsed buildings. Therefore, a team should be prepared to have personnel and supplies that can be used to treat crush injuries, a large number of open wounds, along with a variety of orthopedic injuries. In a disaster involving an explosion (large industrial accident or terrorist attack), the pattern of injuries would include many of the same traumatic injuries as seen in an earthquake, but would also include a large number of burns and blast injuries such as blast lung. Personnel required in this type of disaster should include those with training in caring for burns as well as experience with other traumatic injuries.

In the first days following the Haiti earthquake, there were a large number of complex orthopedic injuries that required emergent treatment. These included open fractures, traumatic amputations, and crush injuries. The treatment of these injuries included fracture reductions, wound debridement, and amputations. Thus it was essential to have personnel with the training to perform the needed procedures. Personnel with training in emergency medicine, general surgery, and orthopedics are best suited to be part of the initial response team when a large number of traumatic injuries are expected.

Supplies that are essential in caring for these patients include plaster splinting/casting supplies, wound dressing supplies, and medications for pain control and sedation. When caring for open wounds, the ability to appropriately irrigate and clean wounds can greatly reduce subsequent secondary infections of these wounds. Response teams should come prepared with supplies that would be able to provide pressure irrigation of wounds with either clean water or saline, antibiotic ointments, and large supplies of wound dressings. A large number of the orthopedic injuries can be treated with casting or splinting. Plaster casting material is far superior in this setting since casts made of fiberglass can not be easily removed without a cast saw, whereas patients/families can be instructed to remove a plaster cast by soaking it in water.

Table 5 provides a list of pediatric equipment that, if possible, should be brought in if not available on site.

Communication in a disaster situation is essential between disaster relief team members as well as with coordinating groups and logistical support personnel in home countries. Modern technology has provided many different types of communication devices, which have different advantages and disadvantages. Communication networks and contingency plans are an essential part of the disaster preparedness phase. Radios are useful for short range communications when a disaster relief team is separated. However, they are limited by range and will not allow communication with the other teams or organizations that are a long dis-

TABLE 5. Recommended equipment to bring for pediatric emergencies in disaster situations.**Airway Management/Breathing**

- Tongue Blades
- Suctioning machine (portable, battery-powered)
- Suction catheters -Yankauer, 8, 10, 14F
- Simple face masks - infant, child, adult
- Pediatric and adult masks for assisted ventilation
- Self-inflating bag with 250 cc, 500 cc, and 1000 cc reservoir
- Optional for intubation
- Laryngoscope handle with batteries (extra batteries AA, laryngoscope bulbs)
- Miller blades - 0, 1,2,3 Macintosh blades 2,3
- Endotracheal tubes, uncuffed - 3.0, 3.5, 4.0,4.5, 5.0, 6.0, cuffed - 7.0,8.0
- Laryngeal mask airways
- Stylets - small, large
- Easycap (ETCO₂ analyzer), 2 sizes
- Adhesive tape to secure ETT

Circulation/Intravascular Access or Fluid Management

- IV catheters - 18-, 20-, 22-, 24-gauge
- Butterfly needles - 23-gauge
- Intraosseous needles- 15- or 18-gauge, or Eazy IO device
- Boards, tape, tourniquet IV
- Pediatric drip chambers and tubing
- 5% dextrose in normal saline and half normal saline
- Isotonic fluids (normal saline or lactated Ringer's solution)
- Medications: epinephrine, atropine, sodium bicarbonate, calcium chloride, lidocaine, D25, D10

Miscellaneous

- Broselow tape
- Nasogastric tubes - 8, 10, 14F
- Splints and gauze padding
- Rolling carts with supplies such as abundant blankets
- Warm water source and portable showers for decontamination
- Thermal control (radiant cradle, lamps)
- Geiger counter (if suspicion of radioactive contamination)
- Personal protective equipment (PPE)
- Pain\ Sedation medications: ketamine, morphine, ketoralac
- Other potential medications: albuterol, keflex, ancef, ceftriaxone, diazepam
- Surgical equipment for amputations, incision and drainage of wounds, laceration repairs
- Headlamps with replacement batteries
- Scissors
- Plaster for casting, not fiberglass (hard to remove)

Monitoring Equipment

- Sphygmomanometer/ Blood pressure cuffs - premature, infant, child, adult
- Portable monitor/defibrillator (with settings < 10)
- Pediatric defibrillation paddles
- Pediatric electrocardiogram (ECG) skin electrode contacts (peel and stick)
- Pulse oxymeter with reusable (older children) and nonreusable (small children) sensors
- Device to check serum glucose and strips to check urine for glucose, blood, etc.

Among the recommended equipment, elements for proper airway management in children are crucial. A major challenge of any disaster response is gathering, organizing, and moving supplies to the affected area. Resource management within the hospital and other facilities or agencies may prove to be a decisive factor in whether a mass casualty event can be handled.

tance away. Satellite phones are ideal for communication with the team as well as with the home country. They provide a reliable method of communication when telephone services are not working or there is no infrastructure, because they rely on orbiting satellites to transmit data. However, they are a scarce resource as well as an expensive resource. The main drawback for many portable satellite phones is that the phone's antenna needs an unobstructed view of the sky. Cellular phones are an ideal method for communication. Voice calls can be made to team members as well as to coordinate in the home country. E-mail and SMS texting are other methods of communicating through the cellular network. However, cellular technology is dependent on a cellular infrastructure and network that has survived a disaster. The cellular networks may also become overwhelmed by the number of people attempting to use it in the time after the disaster, thus emergency/disaster relief providers and organizations need to have a communication system that is reliable and free of interference.

The availability of the internet through various means including satellite links and data over cellular networks has allowed for many novel methods of communication over the internet. There are traditional methods such as electronic mail. Web blogs also allow relief workers as well as those affected by the disaster to reach out to the world. Other social media tools such as Facebook and the microblogging service Twitter allow almost instantaneous updates from the field.

Mental health considerations

Disaster response providers are often thrust in to a high stress situation with exposure to situations they may have never experienced before. The degree of destruction and death will likely be much greater than what the health care providers are accustomed to dealing with in their daily lives. Local first responders and medical providers thrust in to the role of the initial emergency response phase may be faced with the additional stress of personally knowing many of the victims (or their family members) that they are caring for. The emotional impact of large scale destruction, suffering, and death will elicit different responses in different people, but all volunteer providers should recognize how their experiences can affect their well-being both emotionally and physically. The emotional stress experienced by disaster response providers has been well documented after events such as 9/11 and Hurricane Katrina.⁵⁻⁸ The affect of stress is amplified by the long hours of intense work experienced during the response to a disaster. Environmental conditions (such as extreme heat/cold/rain/flooding), lack of sleep, and inadequate nutrition impair a provider's ability to deal with the stressful situation. Crisis response workers and managers, including first responders, public health workers, construction workers, transportation workers, utilities workers, and other volunteers, are repeatedly exposed to extraordinarily stressful events. This places them at higher-than-normal risk for developing stress reactions 9 (Pan American Health Organization [PAHO], 2001).

It is important for all disaster response providers to recognize the potential emotional stress they will be entering before arriving on scene. Stress prevention and management needs to be considered and addressed from the start of the deployment in order to prevent problems. By anticipating stressors and individuals' responses to these stressors, the response team and individuals can potentially prevent a crisis within the team of care providers. The US Department of Health and Human Service, Substance Abuse and Mental Health Services Administration (SAMHSA), and Center for Mental Health Services

(CMHS) have published a guide focusing on general principles of stress management and offers simple, practical strategies that can be incorporated into the daily routine of managers and workers. It also provides a concise orientation to the signs and symptoms of stress. This can be found on-line at <http://mentalhealth.samhsa.gov/publications/allpubs/SMA-4113/default.asp>.

While most people are resilient, the stress response becomes problematic when it does not or cannot turn off; that is, when symptoms last too long or interfere with daily life. **Table 6** provides a list of the common stress reactions.

TABLE 6. Common Stress Reactions

Behavioral	Physical	Psychological/Emotional	Thinking	Social
<ul style="list-style-type: none"> - Increase or decrease in activity level - Substance use or abuse (alcohol or drugs) - Difficulty communicating or listening - Irritability, outbursts of anger, frequent arguments - Inability to rest or relax - Decline in job performance; absenteeism - Frequent crying - Hyper-vigilance or excessive worry - Avoidance of activities or places that trigger memories - Becoming accident prone 	<ul style="list-style-type: none"> - Gastrointestinal problems - Headaches, other aches and pains - Visual disturbances - Weight loss or gain - Sweating or chills - Tremors or muscle twitching - Being easily startled - Chronic fatigue or sleep disturbances - Immune system disorders 	<ul style="list-style-type: none"> - Feeling heroic, euphoric, or invulnerable - Denial - Anxiety or fear - Depression - Guilt - Apathy - Grief 	<ul style="list-style-type: none"> - Memory problems - Disorientation and confusion - Slow thought processes; lack of concentration - Difficulty setting priorities or making decisions - Loss of objectivity 	<ul style="list-style-type: none"> - Isolation - Blaming - Difficulty in giving or accepting support or help - Inability to experience pleasure or have fun

Adapted from CMHS, 2004.

Conclusion

Disasters are, to a great extent, beyond our control and inevitable. However, we can be better prepared for the consequences and thus reduce the degree of human suffering. As Vernon Law has said, "Experience is a hard teacher. She gives the test first and the lessons afterwards." Knowledge and understanding are needed for more effective

preparation and planning. Pediatricians have a special role in the planning and preparation process to ensure that the needs of children are adequately considered in this process. Pediatric volunteers should be prepared for their experiences from the standpoint of training, available materials and resources, and mental health considerations.

SUGGESTED READING

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