Pediatric Education in Disasters Manual

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The incidence of disasters is on the rise worldwide. An estimated 50% of victims of man-made and natural disasters are children. In the last five years, more than 15 million children have been affected by man-made disasters alone. Despite this fact, programs designed to meet the specific needs of children receive low priority and relief workers often lack the special expertise they need to care for children in emergencies.

It is commonly and wrongly assumed that children are resilient and that their reactions to disasters are temporary and, as a result, their psychological and emotional needs may be neglected following disasters, particularly when parents and other adults in their lives are having trouble coping with the events themselves. Children and adolescents are hampered in the help-seeking process by their developmental status, lack of experience and knowledge about how to seek help and, possibly, their lack of awareness of their own distress.

Helping the Children (HTC) is a partnership between the International Activities Office of the American Academy of Pediatrics (AAP) and the Johnson & Johnson Pediatric Institute L.L.C (JJPI). This initiative will raise awareness and increase competence of relief efforts to be sensitive and responsive to the unique physical and psychological needs of children when a disaster occurs.

The HTC initiative:

- Provides meaningful information, programming, resources and follow-up for disaster relief.
- Ensures that programs reflect current child development research to achieve the highest level of quality.
- Invests resources in those communities that are most in need of what the HTC initiative can provide.
- Establishes a pediatric leadership role during relief efforts.
- Provides a clear channel of communication and access for those utilizing the program.
- Ensures strong evaluation and assessment measures, and follow-up are incorporated into the HTC programming.
- Fosters global awareness of the resources.

Based on these guidelines, a Program to train pediatric leaders in the management of Disaster Relief, Care and Rescue for children was developed. The Association for Health Research & Development (ACINDES) was charged with assisting the AAP for the development of the Modules and the organization of the Training Program.
PEDIATRICS IN DISASTERS (PEDS)

The “PEDS” Training Program is divided in 10 Modules, covering those issues that we thought were fundamental to the care of children involved in disasters:

1. Disasters and their effects upon the population: Key concepts
2. Preventive medicine in humanitarian emergencies
3. Planning and triage in the disaster scenario
4. Pediatric trauma
5. Management of prevalent infections in children following a disaster
6. Diarrhea and dehydration
7. Delivery and immediate neonatal care
8. Nutrition and malnutrition
9. The emotional impact of disasters in children and their families
10. Toxic exposures

The Course structure comprises the delivery of lectures and then, the division of trainees in small workshops to develop hands-on activities, such as resolution of different scenarios and discussion of cases. The Training Program is set-up to last 3-4 days, but this curricula is flexible and should be adapted to the specific needs of each country.

PEDS is developed with the collaboration of the Latin American Pediatric Association (ALAPE) and the Pan American Health Organization (PAHO).

In the uncertain world that we live today, children deserve the best protection they can get. We hope that this contribution will help pediatricians in leading the efforts for the betterment of child health and survival.

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Brian Stafford, David Schonfeld, Lea Keselman and Carmen
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**Kathy L. Lehman-Huskamp, William J. Keenan, and Anthony J. Scalzo**

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MODULE I

Disasters and their Effects on the Population: Key Concepts

Julia A. Lynch | Stephen Berman
INTRODUCTION

“Experience is a hard teacher. She gives the test first and the lessons afterwards.”
—Vernon Law

Disasters are to a great extent inevitable and beyond our control. However, we can be prepared for the consequences and thus reduce the suffering they cause to human populations, particularly within our own community. The first steps in preparedness are knowledge and understanding. This module introduces the basic vocabulary and concepts regarding the types of disasters, their common effects, and the national and international organizations most active in disaster relief. At the end of this module we will be able to define some essential emergency relief measures that can help organize individual and community responses.

Pediatricians have a primary role in disaster preparedness because children are among the most vulnerable populations and have unique physiological, psychological, and developmental needs. Pediatricians’ clinical experience makes them experts in the unique nature of children. They have a professional obligation to advocate for the health, safety, and well-being of infants, children, adolescents, and young adults. As you read this module, reflect on your potential role in pre-disaster planning as a health professional responder and as an advocate for the needs of children.
DEFINITIONS

OBJECTIVES

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

CASE

1. You are informed there has been a flood affecting the entire coastal area in a major city of one of the provinces of your country. According to the latest population census, around 200,000 people who are mostly poor live in this area.

- What are the characteristics that indicate that this event can be defined as a disaster?
- What type of disaster is it?

Continues on page 11

What is a disaster?
The World Health Organization and the Pan American Health Organization (WHO/PAHO) define a disaster as an event that occurs in most cases suddenly and unexpectedly, causing severe disturbances to people or objects affected by it, and resulting in loss of life and harm to the health of the population, the destruction or loss of community property, and/or severe damage to the environment. Such a situation leads to a disruption in the normal pattern of life, resulting in misfortune, helplessness, and suffering, with adverse effects on the socioeconomic structure of a region or a country and/or modifications of the environment to such an extent that there is a need for assistance and immediate outside intervention.

Although there are many definitions for disaster (Box 1), three factors are common to all of them:

- an event or phenomenon what represents a trauma for a population or an environment
- a vulnerable point or characteristic that will bear the brunt of the traumatizing event
- the failure of local resources to cope with the problems created by the phenomenon or event

Identifying these factors has practical implications for communities’ preparedness. An adverse event or phenomenon must exploit an existing vulnerability in the affected population or community in order to cause damage; awareness of this will be the basis for an adequate intervention (Figure 1).

Classification of disasters
Disasters can be divided into two broad categories (Box 2):

- Those caused by natural forces
- Those caused by man

An adverse event or phenomenon must exploit an existing vulnerability in the affected population or community in order to cause damage; awareness of this will be the basis for an adequate intervention.

Disasters can be divided into two broad categories: those caused by natural forces and those caused by man.
Natural disasters

Natural disasters are caused by natural forces, such as earthquakes, volcanic eruptions, hurricanes, fires, tornados, and extreme temperatures.

They can be classified as rapid onset disasters such as earthquakes or tsunamis, and those with progressive onset, such as droughts that lead to famine.

These events, usually sudden, can have tremendous effects. For instance, in December 2004 more than 200,000 people died in Southern Asia as a result of a tsunami. Since it is still extremely difficult to precisely predict the climatic and geological changes capable of causing a disaster, preparing for these types of disasters remains a major challenge. Great natural disasters have also occurred recently throughout the Americas (Box 3).

The inability to accurately predict these types of events underscores the need for countries to have disaster response plans to mobilize appropriate resources rapidly and efficiently. A well-defined organizational structure also must be created to coordinate both national and international assistance.

**BOX 1. Definitions of a disaster**

“A disaster is a crisis resulting from a failure in human interactions with the physical and social environment. Disaster situations outstrip the capacity of individuals and societies to cope with adversity.”


“A disaster is the convergence, at a given moment and in a given place, of two factors: risk and vulnerability.”


“A disaster has occurred when the destructive effects of natural or man-made forces overwhelm the ability of a given area or community to meet the demand for health care.”


“A disaster can be defined as a serious disruption of the functioning of a society, causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using only its own resources.”

SECTION 1 / DEFINITIONS

Although significant progress in sanitation and response to disasters has been achieved in certain regions of the world, developing countries continue to be highly vulnerable because of their fragile economy and health care and transportation infrastructure.

BOX 2. Types of disasters

**Natural disasters**
- Hurricanes or cyclones
- Tornadoes
- Floods
- Avalanches and mudslides
- 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

BOX 3. Natural disasters in the Americas in 2007

**Cold Wave**
Peru: June 2007

**Earthquake**
Peru: August 2007

**Epidemic**
Paraguay: Dengue Outbreak - February 2007

**Flood**
- Colombia: Floods and Landslides - May 2007
- Uruguay: Floods - May 2007
- Argentina: Floods - March 2007
- Haiti: Floods - March 2007
- Argentina: Floods - February 2007
- Bolivia: Floods - January 2007
- Peru: Floods - January 2007

**Hurricanes**
- Hurricane Felix - September 2007
- Hurricane Dean - August 2007

**Mud Slide**
Brazil: January 2007

**Tornadoes**
USA: Florida Storm and Tornado - February 2007

**Volcano**
- Colombia: Nevado del Huila Volcano - April 2007
- Montserrat: Volcanic Eruption - Jan 2007

Modified from: www.reliefweb.int

**Man-made disasters**

Disasters caused by man are those in which major direct causes are identifiable intentional or non-intentional human actions. They can be subdivided into three main categories:

*Technological disasters*

Unregulated industrialization and inadequate safety standards increase the risk for industrial disasters. 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 not only with many deaths but also with long-term health effects in the affected population.

Terrorism/Violence
The threat of terrorism has also increased due to the spread of technologies involving nuclear, biological, and chemical agents used to develop weapons of mass destruction. Too often the professionals who must respond to such disasters are not appropriately trained, although several national and international organizations are developing training programs for these types of events.

Complex humanitarian emergencies
The term complex emergency is usually used to describe the humanitarian emergency resulting from an international or civil war. In such situations, large numbers of people are displaced from their homes due to the lack of personal safety and the disruption of basic infrastructure including food distribution, water, electricity, and sanitation, or communities are left stranded and isolated in their own homes unable to access assistance. These settings are often characterized by a breakdown in social and physical infrastructure, including health care systems. Any emergency relief response usually has to be implemented in a problematic political and safety environment.

There has been a global increase in civil war fueled by ethnic confrontations since the mid-1990s (Figure 2). In modern conflicts the greatest loss of life (90%) occurs among civilian nonfighters because of direct physical injury and the public health impact of war (Figure 3).

Complex humanitarian emergencies often result in a staggering loss of lives. Table 1 shows the estimated excessive deaths among civilians in several recent and ongoing crises.

Displaced populations
Natural disasters and complex emergencies can force many people to leave their homes. The specific job of the office of the

![Figure 2. Number of natural and complex disasters in the world between 1985 and 1995](image)

From Humanitarian and Peace Operations. NGOs and Military in the Interagency Process, Workshop Memory, OFDA Briefing sponsored by the Center for Advanced Concepts and Technology.
United Nations High Commissioner for Refugees (UNHCR) is to register and assist displaced populations and individuals. This office recognizes two categories of affected people: refugees and internally displaced persons (IDP).

Refugees flee their countries because of war, violence, famine, or well-founded fear of persecution for political, ethnical, religious or nationality reasons. According to the 2006 UNHCR estimates, there are almost 10 million refugees worldwide (Table 2). A person recognized as a refugee is entitled to certain protections under the terms of international humanitarian laws.

IDPs leave their homes for similar reasons but do not cross the boundaries of their countries. These individuals do not receive the same kind of legal protection, so helping them can be much more difficult. According to the 2006 Internal Displacement Monitoring Centre estimates, there are 24.5 million IDPs worldwide (Table 3). More information is available at http://www.internal-displacement.org.

**Phases of disasters**

Since relief interventions in emergencies evolve as a continuum, the identification of the following four phases is useful to

**TABLE 1.** Deaths among civilian populations during recent complex humanitarian emergencies

<table>
<thead>
<tr>
<th>Country</th>
<th>Deaths</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudan</td>
<td>Over 1 million</td>
<td>1983 to date</td>
</tr>
<tr>
<td>Rwanda</td>
<td>500,000-1 million</td>
<td>1994 to date</td>
</tr>
<tr>
<td>Cambodia</td>
<td>Over 1 million</td>
<td>1975-1993</td>
</tr>
<tr>
<td>Bosnia-Herzegovina</td>
<td>200,000</td>
<td>1992-1996</td>
</tr>
</tbody>
</table>
TABLE 3. Internally displaced persons: global trends

<table>
<thead>
<tr>
<th>Total conflict-related IDP population:</th>
<th>24.5 million (as of December 2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of countries affected:</td>
<td>At least 52</td>
</tr>
<tr>
<td>Most affected continent:</td>
<td>Africa (11.8 million IDPs in 21 countries)</td>
</tr>
<tr>
<td>Countries with highest number of IDPs:</td>
<td>Sudan (5 million), Colombia (3.8 million), Iraq (1.7 million), Uganda (1.7 million), DRC (1.1 million)</td>
</tr>
<tr>
<td>Number of countries with conflicts generating displacement:</td>
<td>23</td>
</tr>
<tr>
<td>Countries with most new displacement:</td>
<td>Lebanon, DRC, Iraq, Sudan, Israel</td>
</tr>
<tr>
<td>Countries with most return:</td>
<td>Sudan, Lebanon, DRC, Uganda, Israel</td>
</tr>
<tr>
<td>Countries with worst displacement situations Chad, (In alphabetical order):</td>
<td>Burma (Myanmar), Central African Republic (CAR), Colombia, Côte d’Ivoire, DRC, Iraq, Somalia, Sri Lanka, Sudan, Uganda</td>
</tr>
<tr>
<td>Estimated number of IDPs exposed to serious threats to their physical safety:</td>
<td>15.6 million</td>
</tr>
<tr>
<td>Countries with governments or occupation forces directly or indirectly involved in deliberately displacing people:</td>
<td>Burma (Myanmar), CAR, Chad, Colombia, Côte d’Ivoire, DRC, Iraq, Lebanon, Kenya, Pakistan, Palestinian Territories, Philippines, Senegal, Sri Lanka, Sudan (Darfur), Uganda (Karamoja), Zimbabwe</td>
</tr>
<tr>
<td>Estimated number of IDPs without any significant humanitarian assistance from their governments:</td>
<td>5 million in at least 11 countries</td>
</tr>
<tr>
<td>Estimated number of IDPs faced with governments indifferent or hostile to their protection needs:</td>
<td>6 million in at least 13 countries</td>
</tr>
</tbody>
</table>

IDP (Internally Displaced Persons); DRC (Democratic Republic of the Congo)
From: Internal Displacement Monitoring Centre. Internal Displacement- Global Overview of Trends and Developments in 2006. Available at: http://www.internal-displacement.org/
better establish priorities and response activities, and to systematize previous experiences:

1. Planning phase
2. Response phase
3. Recovery phase
4. Mitigation and prevention phase

Planning phase
Planning comprises all the activities and actions taken in advance of a disaster. Planning should be based on the analysis of a community’s or organization’s risk for exposure to specific types of disasters. Plans should take into account the frequency of occurrence of each type of disaster, the anticipated magnitude of effect, the degree of advanced warning or suddenness of onset and offset, 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. For more information on planning, see Module 3.

Response phase
Response comprises 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, damage assessment, evacuation, sheltering and other multiple activities. 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.

Recovery phase
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.

Mitigation and prevention phase
This phase takes place during the period of absence of disaster. Mitigation is the phase in which all aspects of emergency management are scrutinized for “lessons learned”; 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 prac-

CASE (cont.)
2. Twenty-five percent of the population affected by the flood are children aged 0 to 12 years old. This population is more vulnerable than others in disaster situations.

- What characteristics make children more vulnerable?
- What specific interventions are necessary to diminish the effects of disaster on children?

Continues on page 18
Effects of disasters

Disasters affect communities in multiple ways. They represent a public health hazard for various reasons (Table 4):

- Can cause an unexpected number of deaths and wounded or sick people that exceed the local resources capacity to respond and require external aid.
- Can destroy health infrastructure not only affecting the immediate response, but also disrupting preventive activities, leading to long-term consequences with increased morbidity and mortality.
- Can have adverse effects on the environment that will increase the risk for infectious transmissible diseases and environmental hazards. This will impact morbidity, premature death, and future quality of life.
- Can affect the psychological and social behavior of the community.
- Can cause shortages of food, with severe nutritional consequences.
- Can cause large movements of the population, both spontaneous or organized, to areas where health services might not be able to handle the excessive requirement.

### TABLE 4. Frequent effects of disasters

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

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.
SECTION II / MORTALITY

The CMR is usually highest during the initial phase of a disaster. Table 5 displays the differences between baseline and peak disaster CMR experienced by displaced populations in different countries.

Additional information regarding these epidemiologic measurements may be found in Module 2: Preventive Medicine in Humanitarian Emergencies.

Vulnerable victims
Immediate mortality in any type of disaster is not higher in a specific age range; instead, it usually reflects the age distribution of the overall population. However, later on the mortality rate associated with the disaster is disproportionately higher among the youngest and oldest people. Figure 4 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

TABLE 5. Differences between baseline and disaster crude mortality rate (CMR) experienced by displaced populations

<table>
<thead>
<tr>
<th>Date</th>
<th>Host country</th>
<th>Country of origin</th>
<th>Reference CMR</th>
<th>Crisis CMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 1991</td>
<td>Ethiopia</td>
<td>Somalia</td>
<td>0.6</td>
<td>4.7</td>
</tr>
<tr>
<td>April 1991</td>
<td>Turkey / Iran</td>
<td>Iraq</td>
<td>0.2</td>
<td>4.2</td>
</tr>
<tr>
<td>March 1992</td>
<td>Kenya</td>
<td>Somalia</td>
<td>0.6</td>
<td>7.4</td>
</tr>
<tr>
<td>July 1994</td>
<td>Zaire</td>
<td>Rwanda</td>
<td>0.6</td>
<td>34.0</td>
</tr>
</tbody>
</table>


FIGURE 4. Age distribution of a population of Kurdish refugees compared with the age distribution of deaths

It is critical to attempt to reunite children with their families as soon as possible and pay special attention to reducing their vulnerability in all disaster response planning.

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.

Five leading medical problems have consistently been found to be the major mortality causes in post-war or post-natural disaster settings among vulnerable populations (Box 5).

Unique features in each disaster (e.g., climate, topography, pre-existing social structure, physical conditions) affect the proportion of deaths associated with each of these, as well as other causes. Figure 5 shows mortality in various displaced populations following natural disasters and armed conflicts. Malnutrition, although not identified as a significant immediate cause of death, is the most important factor correlated to the high adverse consequences, including rape, torture, robbery and exploitation in child labor, child trafficking, and child soldiering. Additionally, because of certain physical and physiological characteristics, infants and children are more vulnerable to the release of toxic substances and the overcrowding associated with the displacement of large populations (Table 6). Consequently, it is critical to attempt to reunite children with their families as soon as possible and pay special attention to reducing their vulnerability in all disaster response planning (Box 4).

### Causes of mortality

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.

Five leading medical problems have consistently been found to be the major mortality causes in post-war or post-natural disaster settings among vulnerable populations (Box 5).

Unique features in each disaster (e.g., climate, topography, pre-existing social structure, physical conditions) affect the proportion of deaths associated with each of these, as well as other causes. Figure 5 shows mortality in various displaced populations following natural disasters and armed conflicts. Malnutrition, although not identified as a significant immediate cause of death, is the most important factor correlated to the high adverse consequences, including rape, torture, robbery and exploitation in child labor, child trafficking, and child soldiering. Additionally, because of certain physical and physiological characteristics, infants and children are more vulnerable to the release of toxic substances and the overcrowding associated with the displacement of large populations (Table 6). Consequently, it is critical to attempt to reunite children with their families as soon as possible and pay special attention to reducing their vulnerability in all disaster response planning (Box 4).

### TABLE 6. Vulnerable pediatric characteristics

<table>
<thead>
<tr>
<th>Pediatric characteristic</th>
<th>Special risk during disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory</td>
<td>Higher minute volume increases risk from exposure to inhaled agents. Nuclear fallout and heavier gases settle lower to the ground and may affect children more severely.</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Higher risk for dehydration from vomiting and diarrhea after exposure to contamination.</td>
</tr>
<tr>
<td>Skin</td>
<td>Higher body surface area increases risk for skin exposure. Skin is thinner and more susceptible to injury from burns, chemicals, and absorbable toxins. Evaporation loss is higher when skin is wet or cold, so hypothermia is more likely.</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Increased risk for thyroid cancer from radiation exposure.</td>
</tr>
<tr>
<td>Thermoregulation</td>
<td>Less able to cope with temperature problems, with higher risk for hypothermia.</td>
</tr>
<tr>
<td>Developmental</td>
<td>Lower ability to escape environmental dangers or anticipate hazards.</td>
</tr>
<tr>
<td>Psychological</td>
<td>Prolonged stress from critical events. Susceptible to separation anxiety.</td>
</tr>
</tbody>
</table>

mortality rates due to transmissible diseases. A study including 41 displaced populations (Figure 6) showed a clear correlation between the crude mortality rate (i.e., death from all causes) and the prevalence of malnutrition.

In the context of a disaster, each of the leading causes of death relates to one or more predisposing environmental conditions that increase the incidence of disease and the mortality rate per case (Box 6). For interventions to be effec-
Aggressive, resources should be targeted to prevent and correct these predisposing environmental factors, in addition to treating the ill individuals. At a World Health Organization conference, international relief experts identified 10 essential emergency relief measures to consider when planning a disaster response. These interventions should not to be implemented in a strict order; priority for each of them is correlated to the particular needs relating to each emergency situation. In addition, these interventions should be adjusted to the particular situation in the affected region.

**FIGURE 5.** Causes of death in children younger than 5 years old in displaced populations due to natural disasters and war in Mozambique

<table>
<thead>
<tr>
<th>Cause</th>
<th>Natural disasters</th>
<th>Malawi, Lisungwe Camp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>25%</td>
<td>16%</td>
</tr>
<tr>
<td>Acute respiratory infection</td>
<td>9%</td>
<td>3%</td>
</tr>
<tr>
<td>Other</td>
<td>22%</td>
<td>3%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>11%</td>
<td>19%</td>
</tr>
<tr>
<td>Measles</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>23%</td>
<td>21%</td>
</tr>
</tbody>
</table>


**FIGURE 6.** Crude mortality rates (deaths per 1,000 individuals/month) in relation to malnutrition prevalence

*Malnutrition Prevalence in Population (%)  
(Malnutrition = <80% weight/height WHO reference population)
Each disaster or humanitarian emergency is a unique situation determined by the event that caused it, climate, geography, culture, social structure, and previous conditions of the affected population. Thus, national and international organizations should initially implement a rapid assessment and resist the impulse to immediately respond before critical information is available. 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. Although similar types of disasters have predictable patterns of disruption as shown in Table 4 (page 12), the degree of severity and type of response is affected by local features.

An appropriate response should be based on the particular needs in each disaster. Continuously reassess the needs at both the local and community levels, where the disaster has occurred, as well as at national or regional levels.

Unpredicted effects may require urgent attention. For example, safe water supply is unlikely to be affected by a strong storm or a mudslide. However, if the regional system for water pumping or purification is affected, the shortage of safe water becomes the key issue that must be addressed to prevent disease and excessive mortality in the affected population. Use resources in a timely manner, within the time frame determined by the disaster. 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.

WHO and PAHO have developed guidelines for the appropriate use of field hospitals in disasters of sudden impact (www.paho.org/disasters).
Essential emergency relief measures

1. Do a rapid assessment of the emergency situation and the affected population.
An assessment should accurately define the needs, so that limited resources will be efficiently used to maximize life-savings and other vital goals.
National level: Assessments are typically done by expert teams focused on promptly defining the emergency 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. Health care professionals should be prepared to assess the health issues in their community, and understand the mechanism of sharing that information with higher levels of authority, in order to contribute to regional or national assessments.
Assessments need to be repeated and the quality and specificity of data improved during the rescue and recovery phases or whenever any major change occurs, such as an aftershock earthquake. Information gathered through the assessments is used by the resource managers to determine the allocation of resources in any large-scale disaster.

2. Provide adequate shelter and clothing.
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. Shelters should be appropriate for the climate. 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.

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. As global food resources improve, establish targeted supplemental and therapeutic feeding programs for malnourished individuals.

4. Provide elementary sanitation and clean water.
The estimated minimum requirement for water is 3 to 5 L/person/day of clean water.
Community level: Re-establish supplies of clean water and effective sanitation and waste disposal services as soon as possible. Vulnerable groups must be considered regarding the access, safety, and security of each plan.

5. Set up diarrhea control program.
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, diar-
rhea 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.**
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. Since vitamin A deficiency is common and contributes to measles-related mortality, consider mass distribution of vitamin A for vulnerable populations.

**National level:** National and international agencies work together to determine if measles immunization or vitamin A distribution is necessary following a particular event. If necessary for all or part of the deemed population, national authorities establish the central logistics (e.g., cold chain, personnel, materials) to manage a mass immunization/distribution campaign.

**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 life losses 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.

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 life losses 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.

**National level:** Health authorities will 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.

**Community level:** Every health care delivery setting should immediately implement a simple but effective health information collection system based on established WHO, PAHO, or governmental guidelines. Health care professionals should know how to share this information regularly with higher level 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)
- Organization of food and water distribution, and the sanitary program
- Health services management
- Corpses and gravesite management
- Identification of unaccompanied minors or other extremely vulnerable individuals (e.g., elderly or persons with a disability) and organization of a caregiver program.

10. Coordinate activities.

**National level:** In a large-scale disaster there will be many national and international agencies attempting to assess, develop plans, and establish priorities for funding at national and regional levels. Most effective relief efforts have resulted from effective collaboration between many agencies, each bringing their own expertise and experience. However, all of these agencies will ultimately depend on quality assessments from the affected communities to make appropriate decisions and determine the ability of the communities to implement the plans and projects that will help diminish suffering and restore the baseline situation in the communities.

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

Organizations capable of providing assistance during humanitarian emergencies

When local resources are insufficient, assistance from multiple national or perhaps multinational 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 international agencies may have activities in the country prior to the event. In response to the disaster these agencies may retarget their resources in the country to 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

Governmental organizations work under the authority of one or multiple governments. The most common include:

National ministries—These are agencies at the national ministry level that have authority for disaster planning and response. A regional conference on disasters took place in 1986 to optimize the preparedness and response mechanisms of Latin American and Caribbean nations. As a result of this conference, most nations established a health disaster coordinator within the Ministry of Health (MoH.) The health disaster coordinator not only coordinates health-related relief efforts in the event of a disaster, but also continuously updates emergency plans and conducts preparedness training for health care professionals.

Pan American Health Organization (PAHO)—This is an international public health agency serving as the Regional Office for the Americas of the World Health Organization. It provides health policy guidance and technical assistance in disaster planning and response (Box 7). More information is available at: www.paho.org.
**World Health Organization (WHO)** — The WHO provides technical advice and develops health policies relating to disasters. More information is available at: [www.who.int](http://www.who.int).

**SUMA (Humanitarian Supply Administration System, developed by the PAHO)** — This organization facilitates the reception, inventory, and rapid distribution of essential humanitarian supplies and equipment. In the event of a disaster, PAHO can send SUMA-trained staff to the affected country to assist in managing the inflow of supplies.

**United Nations (UN)** — The UN is a multinational organization that functions mainly through its sub-agencies, which are independently funded. More information is available at: [www.un.org](http://www.un.org).

**World Food Program (WFP)** — This organization coordinates the delivery of food to regions in need around the world. More information available at: [www.wfp.org](http://www.wfp.org).

**United Nations International Children’s Emergency Fund (UNICEF)** — This organization was created by the UN General Assembly to advocate and protect children’s rights, to help fulfill their basic needs, and to provide opportunities for maximizing the development of their potential. When an emergency occurs, UNICEF focuses on ensuring that basic needs of women and children are fulfilled and on protecting their basic rights. More information is available at: [www.unicef.org](http://www.unicef.org).

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**Box 7. Some technical recommendations for disaster situations issued by the PAHO**

- **Specific topics related to disasters** — For example, frequent effects of specific types of disasters, such as volcanic eruptions.
- **Special needs** — Special considerations regarding vulnerable groups.
- **Transmissible diseases** — Vector control; specific behaviors for cholera and tuberculosis in the context of disasters.
- **Food safety** — Guidelines for food preparation and nutrition.
- **Immunization** — For example, the adequate use of measles and equine encephalitis vaccines in the context of disasters.
- **Environmental sanitation** — Rodent prevention; general health recommendations for camps and shelters; guidelines for temporary shelters.

Source: [www.paho.org](http://www.paho.org)
Office for the Coordination of Humanitarian Affairs (OCHA)—In 1998 the OCHA resulted from the reorganization of the UN Department of Humanitarian Affairs (DHA). Its mission was expanded to include the coordination of humanitarian response, policy development, and advocacy. OCHOA’s tasks are done through the Inter Agency Permanent Committee that includes multiple participating organizations, such as UN agencies, funds, and programs, the Red Cross, and NGOs. More information is available at: http://ochaonline.un.org.

Foreign organizations that provide help in case of disaster—Box 8 identifies some of the governmental agencies of developed countries that provide funding and technical help to countries affected by humanitarian emergencies.

PAHO and WHO have developed guidelines to assist disaster-affected countries in managing donor offers from various agencies. According to the 1999 PAHO publication *Humanitarian Assistance in Disaster Situations: A Guide for Effective Aid*, “In the most advanced developing countries, in particular in Latin America, national health services, voluntary organizations and the affected communities mobilize their own resources to meet the most compelling medical needs in the early phase after a disaster. Requirements for external assistance are generally limited to highly skilled expertise or equipment in a few specialized areas.”

Military help—Both local and foreign 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.

### BOX 8. 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 work/humanitarian assistance/disaster assistance)

- **Canadian International Development Agency (CIDA)**
  
  [www.acdi-cida.gc.ca](http://www.acdi-cida.gc.ca)

- **European Commission Humanitarian Organization (ECHO)**
  
  [www.acdi-cida.gc.ca](http://www.acdi-cida.gc.ca)

- **United Kingdom Department for International Development (DFID)**
  
  [www.dfid.gov.uk](http://www.dfid.gov.uk)

- **Japan International Cooperation Agency (JICA)**
  
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. See the WHO-PAHO guidelines for the use of field hospitals in sudden-impact disasters.

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 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. Political objectives: The military are an asset of governments; in addition, certain humanitarian objectives can be subordinated to other political or strategic goals. The presence of the army in certain scenarios can cause tension in certain groups of the population and compromise relief workers who, for their own safety and function, wish to be considered neutral. 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). Only a few of them have the resources required for supporting activities targeted to promote development and to respond to disasters in multiple countries or regions. Each NGO is specialized in specific aspects of assistance in emergencies (Box 9). Although NGOs may receive contributions from individuals, most of their funds come from the governments of industrialized countries. These governments distribute their money for assisting projects through contracts with NGOs. Unlike the International Committee of the Red Cross (ICRC), some NGOs maintain a “right to interfere.” This means they can operate across borders without written approval of their hosts. Although usually looking for the neutrality of the
ICRC, some NGOs may be more willing to report any perceived injustice. They perform well in emergencies within their area of specialty (e.g., water provision, food distribution), but most cannot achieve self-sufficiency in an emergency setting and rely on UN, military, or other agencies for security, transportation to remote sites, communication, support of logistics, or medical care for their own personnel. NGOs have 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.

**International Committee of the Red Cross (ICRC)**—This is a hybrid agency: neither private nor controlled by a government. A number of its characteristics are unique; its mission is defined by the international humanitarian law passed by the 1949 Geneva Convention and the two 1977 protocols. The ICRC gets involved mainly when civil disturbances are present; it has the right and duty to intervene across borders when national or international conflicts break out, regardless of whether a “state of war” has been declared. The ICRC brokers relief assistance during war, assures legal protection for victims, and monitors the way Prisoners of War are managed. Also, the ICRC plays a critical role in reuniting families. The ICRC strives to preserve its neutrality, which is essential for its mission and enables its members to work unarmed in war regions under the control of any of the involved parties. The ICRC provides a complete account of its activities to all the parties involved in the conflict. It will refuse to participate in any activity that can be seen as showing favoritism. This may include trans-

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**BOX 9. Most important NGOs and their specialization fields**

- **Cooperative for the American Relief Everywhere (CARE)**
  Assistance in logistics and feeding; camp management
  www.care.org

- **Catholic Relief Services**
  Food distribution
  www.crs.org

- **Médecins sans Frontières**
  Medical care
  www.paris.msf.org

- **Irish Concern**
  Feeding supplementation

- **Oxford Committee for Famine Relief (OXFAM)**
  Water and sanitary services
  www.oxfam.org.uk

- **Save the Children Fund**
  Assistance in feeding and development
  www.savethechildren.org.uk

- **World Vision**
  Assistance in feeding and development
  www.worldvision.org

- **International Rescue Committee**
  Medical care
  www.theirc.org
portation in vehicles belonging to one of the parties or joining efforts with groups that have their own interests. The ICRC is usually self-sufficient and can use its own resources for air lifts, communication, and logistics. It will participate only if all parties involved in the conflict sign an agreement recognizing and showing respect for its neutrality and mission. The ICRC is related to but independent from the Red Cross and the Red Crescent Societies national agencies. These organizations provide assistance primarily to victims of disasters or wars within their own nations. They have a similar commitment with neutrality, provision of assistance based only on the need, and independence from national governments.

**Coordination of organizations**

Coordinating the activities of all these organizations poses a tremendous challenge. Following a natural disaster the host nation’s government/agencies and military are likely to have operational command. Most nations now have defined governmental authorities responsible for global disaster planning and response, as well as coordinators for individual sectors such as health. External agencies or governments play a supportive role in providing technical

It is critical to attempt to reunite children with their families as soon as possible and pay special attention to reducing their vulnerability in all disaster response planning.
assistance and resources. PAHO has developed a number of technical manuals and training activities to assist nations in the planning of coordinated disaster responses at the regional and national level.

In complex emergencies related to a conflict, the armed forces or government authorities will have the command of operations, including the coordination of humanitarian help. The coordination in this scenario can be particularly difficult if the hostile groups are stationed nearby and try to block assistance of civilians. In this context, humanitarian help can be used as a political and strategic instrument.
SUMMARY

Pediatricians are uniquely positioned to play a leading role in disaster preparedness. As important community members, pediatricians can help to establish the necessary links among families, children, schools, the community, and governmental agencies. We hope that the increased understanding of disasters achieved after completing this course will lead you to become active in efforts targeted to disaster planning and response in your community and country.

SUGGESTED READING


Sharp TW. Conflict-Related Complex Emergencies, in Chap. 34, Military Preventive Medicine, 1997.


Case resolution

1. A disaster can be defined as a usually sudden event causing damages, affecting many people, and because of its magnitude, exceeding the capacity for response of local or national organizations. High morbidity and mortality rates are frequently found in the affected population, which is often exposed to critical sanitary situations, both immediately after the disaster and during subsequent phases. There is an additional risk for diseases associated with crowding and lack of adequate public services.

Disasters can be due to natural causes, such as hurricanes and earthquakes, alterations, or technological causes related to events triggered by man's intervention (e.g., the release of toxic or radioactive agents). In addition, civil and international wars cause complex emergencies that affect civilians and result in their displacement.

In this case, flooding has brought about a natural disaster.

2. Children, as well as the elderly and pregnant women, are the most vulnerable populations when a disaster occurs. For children, the risk of being separated from their families determines their vulnerability. In addition, their physical, physiological, and mental features render them more susceptible to environmental, sanitary, and social changes resulting from disasters.

All affected children should be identified and their identity should be properly documented. They should also receive preferential attention during the distribution of sanitary and feeding resources as well as effective preventive interventions.

3. The initial and highly critical step is the immediate assessment of the situation and the affected population. This will define the actual needs and the interventions that are most appropriate in the current circumstances. It is important to establish clearly defined priorities and effective coordination of rescue activities during both the early and the subsequent phases.

In this case, field hospitals are unlikely to be needed, because traumatized victims requiring immediate interventions will be less numerous than in other circumstances, when disasters have a more sudden and unexpected start. (e.g., earthquakes)

The capacity for response of local and regional services will determine whether external assistance is needed. Immediate external help is unlikely to be necessary in this case, but there will probably be a need for resources to provide the affected population with shelter and clothing.
## Myths and realities of disasters

The Pan American Health Organization has identified many myths and erroneous beliefs that are widely associated with the public health impact of disasters; all disaster planners and managers should be familiar with them.

<table>
<thead>
<tr>
<th>MYTH</th>
<th>REALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign medical volunteers with extensive medical training are needed.</td>
<td>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.</td>
</tr>
<tr>
<td>Any kind of international assistance is needed, and it is needed now!</td>
<td>A hasty response not based on an impartial assessment only contributes to chaos. It is better to wait until real needs have been assessed. In fact, most needs are met by victims themselves and their local government and agencies, not by foreign parties.</td>
</tr>
<tr>
<td>Epidemics and plagues are inevitable after every disaster.</td>
<td>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 affected population.</td>
</tr>
<tr>
<td>Disasters bring out the worst in human behavior (e.g., looting, rioting).</td>
<td>Although isolated cases of antisocial behavior exist, most people respond spontaneously and generously.</td>
</tr>
<tr>
<td>The affected population is too shocked and helpless to take responsibility for its own survival.</td>
<td>On the contrary, many people 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.</td>
</tr>
<tr>
<td>Disasters are random killers.</td>
<td>Disasters strike hardest on more vulnerable groups: the poor, and especially women, children, and the elderly.</td>
</tr>
<tr>
<td>Relocating disaster victims to temporary settlements is the best alternative.</td>
<td>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.</td>
</tr>
<tr>
<td>Food aid is always required for natural disasters.</td>
<td>Natural disasters only rarely cause loss of crops. Therefore, victims do not always require massive food aid.</td>
</tr>
<tr>
<td>Clothing is always needed by the victims of a disaster.</td>
<td>Used clothing is almost never needed; it is often culturally inappropriate and although accepted by disaster victims, it is almost never worn.</td>
</tr>
<tr>
<td>Things are back to normal within a few weeks.</td>
<td>The effects of a disaster last a long time. Disaster-affected countries lose much of their financial and material resources in the immediate post-impact phase. Successful relief programs gear their opportunities to the fact that international interest wanes as needs and shortages become more pressing.</td>
</tr>
</tbody>
</table>
Preventive Medicine in Humanitarian Emergencies

Douglas A. Lougee | Ángela Gentile
In a post-disaster scenario, health workers are faced with many challenges. For example, they may be concerned for the safety and well-being of their own families as well as the health and well-being of their patients. Most will have an innate desire to help their community. Depending on the specific scenario, pediatricians may have to use skills that are beyond those of everyday practice, such as trauma care in the immediate aftermath of an earthquake. However, in any disaster situation, preventive medicine and public health techniques are likely to be most useful for overall community recovery.

At its core, preventive medicine focuses on the use of population health data and public health strategies to improve the health of an entire community. After a disaster, the day-to-day public health infrastructure is suddenly disrupted. Much as the autonomic nervous system maintains bodily functions without conscious effort, this infrastructure is working day and night to maintain community health but exists mostly out of the consciousness of most clinicians. With sudden disruption of the public health services, the community faces potentially catastrophic consequences, particularly through increased risk of infectious diseases. In these situations, supporting the re-establishment of the public health infrastructure is a higher priority than evaluating and curing individual patients.
GATHERING AND USING POPULATION DATA

OBJECTIVES

- Recognize the difference between standard clinical practice and preventive medicine.
- Recall the ways in which, after a disaster, public health measures have a higher priority than evaluating and treating individual patients.
- Describe and apply population evaluation tools such as rates and the analysis of the underlying causes of disease present in a given community affected by a disaster.

Preventive medicine: Public health mindset

In clinical practice, pediatricians spend most of their time diagnosing and treating patients one at a time. Most health care is focused on curing the patient. Preventive medicine, rather than trying to cure the individual patient, focuses on the underlying causes of illness in society and employs public health techniques to address these problems at the population level (Box 1).

CASE

After an earthquake, a food poisoning outbreak was detected in a club used as a shelter. An epidemiologist conducted the investigation. On his arrival, Dr. HN was informed that on the previous night all the affected persons had eaten at the club. The investigation focused on the meals served the previous evening. Seventy-five of the 80 persons who had been present were interrogated about symptoms, including date and time of their onset. There were 46 persons with symptoms of gastroenteritis.

1. Can the situation be considered epidemic?
   In all cases, the symptoms, primarily nausea, vomiting, diarrhea, and abdominal pain, had an acute onset. None of the persons had fever. They all recovered spontaneously in a 24 to 30 hour period. Approximately 20% of the persons who had dinner at the club sought medical care. Samples for fecal culture were not obtained.

2. List the diseases that should be considered in the differential diagnosis when an outbreak of acute gastroenteritis occurs.
   Dinner had been prepared simultaneously by several people and had been served in the club yard between 6 p.m. and 11 p.m. The meals had been distributed on tables and eaten during a period of several hours. All 75 interviewed persons were interrogated the time of onset of symptoms and the meals and beverages he/she had. A table was created using these data. The exact time of food ingestion could be established in only about half of the cases.

(Continues on page 41)
The preventive medicine “patient” is considered a group of people, a population, or an entire community with sub-groups within that community. The first step is to obtain rates, which are a fraction representing numbers of cases of specific conditions over number of people in a specific population. This is particularly critical in post-disaster scenarios where resources, such as time, are more constrained than usual.

To obtain rates, one must have both a numerator and a denominator. The numerator is the number of a specific type of problem or a case, and the denominator is the number of people in the community who are at risk for the problem. The resulting number can be reported as a fraction, a percent, or a rate. All of these convey useful information and can be converted from one to another, but using rates facilitates the comparison between the reality of one community and that of others. They also help assess through time the success of interventions in a given population.

Determining rates is a skill that many clinicians do not use on a daily basis, but it is critical to understanding health problems in a community. Without this data, scarce resources will not be used rationally for the good of the community.
a rate is the way that most public health practitioners “speak” to each other and is probably the most useful (Boxes 3, 4).

The value of a rate is dependent on the quality of the data that go into its creation. For accurate numerators, cases must be defined clearly so that a busy clinician can easily categorize problems. For example, a typical case definition would be 3 or more watery stools for a diarrhea case. Consistency in defining cases is key to ensuring the comparability of rates from different areas or following them over time.

Equally important to determining accurate numerators are accurate and descriptive denominators. For this, basic demographic information is needed, such as the total number of people affected in the community and the population structure, including gender breakdown and number of people in specific age groups. In a disaster scenario, the simplest way of subdividing groups by age is to classify them under 5 years, 5 to 15 years, and over 15 years. It might be useful to subdivide this last group into 15 to 60 and over 60.

The most critical rates to follow after a disaster are mortality (death) rates. The daily crude mortality rate (CMR) is determined by taking the total number of deaths in a population (community), dividing it by the total number of people in that population, and multiplying that number by 10,000 (Box 5).

For example, if a community has a population of 15,955 and it experiences 49 deaths in 7 days, the CMR will be 49 / 15,955 x 10,000 = 30.7 deaths per 10,000 people in one week. To arrive at the daily CMR, which is the international standard for gauging disaster severity and effectiveness of response, divide this number by 7 to get a daily CMR of 4.4 deaths per 10,000 people per day.

The mortality rate of children under 5 years, i.e. the number of deaths in children younger than 5 years, is another impor-
Important measure to assess the severity of a disaster and the capacity for response. It is important not only because it shows the effects of the disaster on children, but also because children are the most vulnerable members of society. This age group is usually called the “sentinel population,” because changes will become evident sooner than in other age segments. Health care workers should worry when the mortality rate reaches 2 deaths/10,000 children age <5/day. The situation is considered severe when this rate mounts to 4 deaths/10,000 children age <5/day.

Attack rates are also usually utilized during disaster situations. These rates express the relation between the number of newly diseased persons (cases) and the total population at risk. Attack rates are incidence rates, i.e., they reflect the number of new cases in a given population. On the other hand, prevalence rates measure the proportion of cases of different diseases in a given population. They express the specific weight of a given disease with relation to the aggregate of all diseases, and allow establishing priorities in the management of diseases and the use of human resources. However, in contrast to incidence rates, prevalence rates do not reflect the risk of an epidemic.

**BOX 5. Crude mortality rate (CMR)**

\[
\text{Total number of deaths in a group} \times \frac{10,000}{\text{Total number of persons in this group}}
\]

Expressed as deaths per 10,000 persons per day. The objective is <1/10,000/day.
OBJECTIVES

- Recall major components of a population evaluation: demographics, pre-disaster health conditions, an emergency needs assessment, health care system evaluation, and establishing a surveillance program.
- Complete the major components of an emergency needs assessment.
- Draft disaster-response plans using community resources (transportation, communication, security).

Population evaluation

Pediatricians can facilitate post-disaster recovery in their communities by helping to assess local population conditions. It is important to obtain as much hard data as possible—do not depend on speculation. Too often, disaster relief efforts are hindered and resources are squandered by well-intentioned people acting without the background of sound epidemiologic data. **Box 6** describes the components of a population evaluation.

Demographic data

In a disaster, collecting data on population characteristics (number, age groups, ethnicity, gender) is critical. The crudest form of counting people is by air. This is by far the least accurate way of assessing the scope of a disaster, but it may be all that is possible in some situations. Visual estimates from the ground may be used as well to get a quick count of the affected population.

More accurate method to assess the affected population and its structure is by using standard sampling techniques, such as...
The most accurate way to gather demographic information is to count all individuals and list them by age group and sex. Vulnerable groups (such as children under 5 years and/or without a family, breastfeeding mothers, pregnant women, the elderly, and the injured) need particular attention and must be identified. Although counting people and groups may be tedious, this is a top priority. Without accurate demographic data, it will be difficult to determine the true nature of what is happening in a community, and scarce resources may be wasted.

### Pre-disaster health conditions

Baseline health data may be obtained from local health authorities. Immunization records provide a good source of demographic data. Health workers can provide basic information on what type of health problems were present in the pre-disaster community as well as the areas that are most likely to be affected, such as the most vulnerable households.

Pediatricians can maximize their disaster preparedness by being active in preparing community health plans and taking the lead in helping with community disaster drills. The ideal situation would be for all public and private health care workers to meet periodically to discuss community health problems and practice disaster drills. This would increase their knowledge of the community and its health problems, and would allow to relationships to be built between the public and private sector before a disaster strikes.

### Emergency needs assessment

A needs assessment looks at what a community lacks as well as what resources and capacities it can use to address problems. The objective of a needs assessment is to identify gaps between current community needs and resources. Whenever possible, it is preferable to close these gaps by mobilizing local resources immediately instead of waiting for outside assistance. Emergency needs assessments (also called rapid needs assessments) are

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### BOX 6. Population evaluation

- Demographic data
- Measures of health status prior to the disaster
- Evaluation of the emergency needs
- Establishment of a morbidity/mortality surveillance system

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### BOX 7. Demographic data

- Affected population count (high priority)
- Visual estimation
- Sampling
- Census
- Population structure: male/female and age segments (<5 years, 5-15 years, >15 years)
- Risk groups: young children, pregnant and lactating women, elderly and wounded people
focused on those needs that can ameliorate the greatest amount of morbidity in the community (Box 8).

Security, transportation, and communication are also key elements of an emergency community needs assessment; however, these components may fall outside the traditional healthcare realm. They will be covered in greater detail under “Conditions of other community resources” at the end of this section.

**BOX 8. Critical items in the evaluation of the emergency needs**

- Drinking water
- Nutritional status
- Shelter
- Basic sanitation
- Local environmental conditions
- Public health needs

**Water**

Water is critical to survival and must always be a top priority. Quantity of water is a higher priority than quality in the immediate post-disaster scenario, but provision of clean water will do more to prevent the spread of disease than any other preventive medicine intervention. Estimates of water quantity needs are at least 3 to 4 liters/person/day only for drinking. However, the water needs will increase to 15 to 20 liters/person/day when cooking, cleaning, laundry, and personal hygiene are taken into account. Immediate identification of water sources and ways to protect these resources and improve water quality is a top priority. If there is no certainty that water is safe, it can be chlorinated by adding 2 drops of bleach (sodium hypochlorite solution) per liter of water.

**Nutritional status**

Nutritional assessments take into account community needs as well as local resources. Again, data, not speculation, is needed. Whenever possible, community pre-disaster rates of protein energy malnutrition (PEM) should be obtained as a baseline. During post-disaster situations, rates of acute PEM within the community and community sub-groups should be obtained as soon as possible to facilitate targeting food resources where they are needed most. Acute PEM rates are obtained by doing nutritional surveys of children under the age of 5 years. This group is called the sentinel population and is used to determine the nutritional status of the entire community, because children under age 5 years show the effects of acute undernutrition sooner than any other age group. According to the World Health Organization (WHO), if the percentage of children under age 5 who suffer from acute malnutrition reaches 10%, this indicates that a community is suffering from severe lack of food resources.

Malnourished children are those whose weight-for-height score is less than 2 standard deviations of the mean (z scores) or
have edema. If mid-upper arm circumference is used, children with scores of less than 12.5 cm can be used as a cut-off to estimate malnutrition. If ages of children are unknown, then those whose heights are from 65 to 110 cm can be used as the sentinel population to be checked.

Common sampling techniques for surveying children's nutritional status (or other health condition) include random selection (simple or systematic) or cluster sampling. Simple random selection can be done if all the children can be identified, such as by immunization records or a camp census. They are assigned a number and then a random number table is used to select those who will be evaluated for nutritional status.

Systematic random sampling is done by checking every $n$th household to get enough children for a representative sample. This is useful if the households are reasonably neatly ordered, such as ordered in rows of tents. The interval between each household that is sampled ($n$) is determined by the total number of households in the community divided by the number of households you wish to sample. For example, to check the nutritional status of children in 450 households out of a total of 2,800 households, you would check every sixth household (2,800 divided by 450). The first household to be sampled would be determined by randomly selecting a number between 1 and 6. Survey teams would then check the nutritional status of children in every sixth household, beginning with the randomly selected one.

Cluster sampling is a statistical sampling technique that is used for large numbers of people and is beyond the scope of this discussion. A public health professional with training in epidemiology or a standard text on this subject could be used to design a survey using cluster technique.

If random selection (simple or systematic) is used, a sample size of about 450 children is needed. If cluster sampling is used, the sample size should be of about 900 children for an accurate population estimate. If the community size is small enough, it is more accurate to simply check all the children who are in the sentinel population age range.

It is important to bear in mind that the sample size will depend not only on the population size but also on the frequency of the phenomenon being investigated; i.e., the prevalence of this phenomenon in the community.

Other elements of the nutritional needs assessment include food availability, food security, distribution throughout the community, and cultural factors that affect nutrition. The recommendation for caloric needs in a displaced population is 1,900 to 2,100 Kcal/person per day.

Shelter
For shelter, the WHO recommends 3.5 to 4 meters squared (M²) per person as the absolute minimal amount of floor space for
a displaced population. A rapid assessment of available remaining space will identify any disparity between needs and capacity. Pre-disaster planning should emphasize the use of community spaces such as schools, churches, and assembly halls for emergency shelter. Plastic tarp, wood supplies, and other emergency shelter supplies should be set aside and ready for use when necessary.

**Basic sanitation**
Basic sanitation is aimed at preventing spread of communicable diseases from indiscriminant defecation. Feces are a concentrated source of human pathogens and can lead to explosive outbreaks of diarrheal diseases. In a post-disaster scenario, effective control of human waste is a top priority. One person can contaminate water used by thousands, and flies can spread fecal material to food supplies, rapidly creating hundreds or thousands of cases of food and waterborne illness.

**Local environmental conditions**
Conditions that affect community health, such as smoke, chemical spills, floods, landslides, collapsed buildings, terrain slope, drainage, and insect vectors, are all important to assess during disaster situations.

**Health needs**
The emergency assessment of health needs is focused on mortality rates and chief causes of morbidity. Death is the most severe negative health outcome and it must be tracked carefully to understand what is happening in a community. Typical baseline mortality rates in a developing nation are 0.5 deaths per 10,000 population per day or 1 death of children under 5 years of age per 10,000 children per day. Rates higher than this indicate the severity of the disaster and the need for rapid response to community needs. To provide the most accurate information, mortality data should be reported by age, sex, and cause of death.

Morbidity data is also of key importance for understanding community health needs. This data is captured by using patient logbooks that record age, sex and chief diagnosis of the patient. The Pan American Health Organization (PAHO) and local Ministry of Health personnel are good sources of patient logbooks. This data can be rapidly analyzed to gain an understanding of the chief health threats to the community and used to plan the use of resources accordingly.

**Health care system evaluation**
While not a part of the traditional emergency needs assessment, an evaluation of community health care resources, including human resources, medical supplies, equipment, surgical capability, and condition of health care buildings, is also an important part of the process following a disaster. From the preventive medicine standpoint, evaluation of the availability of vaccines and the condition of the cold chain is extremely important.

Evaluation of the health care system requires pre-disaster knowledge of com-
munity resources. By joining with public health officials and disaster planning committees, pediatricians can be included in community health care worker rosters and will learn where emergency medical supplies are stored. Organized plans for signaling an emergency and identifying a specific location to convene as a group would lead to rapid mobilization of all health care workers in case of an emergency. Pre-disaster planning by delegating responsibilities for assessing the condition of local hospitals and clinics and determining available medical supplies will avoid confusion and wasted efforts.

Establishing a system of morbidity and mortality surveillance
After a disaster, it is critical that all health care workers, both private and public, join together to form an integrated and coordinated system that records and reports diseases. This is one of the most important roles of health workers who are engaged in a traditional clinical consulting mode. To the clinician who is working long hours trying to treat as many patients as possible, gathering data may seem like a waste of time, but it is crucial for planning disaster response.

The ideal situation would be to have every health worker use the same type of patient logbook to record the age, sex, and diagnosis of each patient. This information should be collected and recorded in a systematic way and provided in a timely manner to public health authorities so they can analyze it and rapidly respond to emerging health threats.

Conditions of other community resources
Transportation and communication resources
Transportation and communication are critical components of the disaster response strategy. Two-way communication systems such as radios, telephone, and Internet capability are critical for disseminating information, communicating among disaster workers, and planning outside help. Knowing the percentage of households with televisions and radios will help tailor the use of mass media for providing emergency instructions and health education. The condition of roads, waterways, and landing strips/fields is also important for evacuating people who are injured and receiving emergency aid. Motor vehicles, fuel sources, boats, and even beasts of burden and carts may be important for rapidly establishing a logistical bridge into disaster-affected areas.

Security
Security is another need that is sometimes overlooked by health workers. Security may be needed to carry out the initial rapid emergency needs assessment. While they probably will not be called upon to establish security for disaster-affected populations, health workers can facilitate protection from crime, looting, and
exploitation by sharing information regarding criminal activity with security forces. Health workers can also provide security for unaccompanied minors by quickly taking control of these children and keeping them safe from exploitation until family reunification or another permanent solution can be achieved.
POST-DISASTER INTERVENTION PRIORITIES

OBJECTIVES

- Establish emergency intervention priorities following a disaster.
- Describe how the modes of disease transmission affect the intervention priorities after a disaster.

CASE (cont.)

5 Determine the future investigations that should be carried out.
6 What control measures would you implement?

Modes of disease transmission

Post-disaster living conditions frequently enhance the transmission of infectious diseases. Understanding how these conditions pose health threats will help set priorities for public health interventions. The most common modes of transmission after a disaster are fecal-oral, respiratory, and vector borne. Fecal-oral transmission can occur by having human waste enter into the water supply by indiscriminant defecation, by flies carrying feces on their feet to food sources, or from unwashed hands.

Fecal-oral transmission has the greatest potential for rapid spread of infection among a displaced population, particularly if the water supply becomes contaminated. The respiratory route is enhanced by the crowded conditions that frequently follow a disaster. Also, respiratory irritants such as smoke from open cooking fires may increase predisposition towards the spread of respiratory pathogens. Vector-borne illnesses such as malaria and dengue frequently increase following disasters, particularly floods or hurricanes because standing water increases mosquito breeding.

Infections are usually referred to when the notion of transmission is being discussed, because infection transmission is easier to prove objectively. In contrast, the epidemiologic evidence of causality in the transmission of noninfectious diseases is more difficult to demonstrate. An example is lung cancer associated with cigarette smoking.

There are four modes of transmission of infectious diseases: contact, common source, airway transmission, and transmission by vectors.
Contact
This necessitates a connection between the host and the infectious agent that causes the disease. The contact can be:

- **direct**: involves person-to-person contact, as in the case of the fecal-oral route, in which the microorganism contained in the feces of an infected person is transmitted, due to defective hygiene conditions, to another person, usually another household member. Examples: hepatitis A, *Salmonella*, *Shigella*. An additional example is the contact with a *Staphylococcus aureus*-infected wound.
- **indirect**: through an inanimate object. Example: hepatitis B, due to the shared utilization by family members of objects such as tooth brushes.
- **through droplets**: person-to-person transmission through droplets emitted by the mouth or nostrils. The longest distance that droplets travel in the air is approximately 3 yards. Examples: measles, chickenpox, streptococcal disease.

Common source
A microorganism or a toxin can cause disease in one or several persons from a common source that contains the infective agent. Example: gastroenteritis outbreaks resulting from contaminated food (ice cream, mushroom sauce) (Box 9).

Transmission through the air
Microorganisms can travel more than 3 yards in the air from the source of infection. Traveling microparticles usually result from the evaporation of drops emitted by the source of the disease. Examples: tuberculosis (through the cough of a diseased person); psittacosis (from a diseased fowl to a person); Q fever (from contaminated products; can travel several miles); *Legionella* (through air conditioning systems).

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**BOX 9.** The most common sources for disease transmission

- Water
- Food
- Blood products
- Intravenous saline
- Intravenous drugs

Transmission by vectors
Transmission by vectors can be external or internal. In the external transmission, the vector carries the unmodified infective agent on its body. Example: flies carry *Salmonella* acquired from contaminated feces and deposit the bacteria on food that is later ingested by the host (human being or animal). In the internal transmission, the microorganism travels inside the body of the vector, where it may remain unaltered (*Yersinia pestis* is ingested and then eliminated unchanged) or may be modified, as in *Plasmodium falciparum* transmission by the mosquito.

Although for the sake of clarity the varied forms of transmission have been differentiated, transmission can occur by one or several modes (Table 1).
Public health priorities
The objective of post-disaster health interventions is to minimize death and prevent excess disease. Another public health priority is to facilitate community preparation for future disasters. Public health priorities are based on these goals while avoiding excess deaths, which is the most important goal in the immediate aftermath of a disaster. Ideally, all interventions will take place with the guidance of a thorough emergency needs assessment and ongoing evaluation of the team’s effectiveness during a disaster situation.

Of those who survive the immediate inciting event, the leading causes of death in disasters typically are diarrhea, acute respiratory infections, measles, malaria, and malnutrition. Malnutrition kills people and more commonly contributes indirectly to death from other causes. Understanding these causes of death as well as the modes of disease transmission will lead directly to specific public health interventions.

According to the World Health Organization (WHO), immediate public health interventions include the following priorities:

- Provide safe drinking water
- Control human waste
- Protect food supply
- Vector control
- Provide adequate shelter

<table>
<thead>
<tr>
<th>Transmission</th>
<th>Bacteria</th>
<th>Viruses</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fecal-oral</td>
<td><em>Salmonella</em></td>
<td><em>Hepatitis A</em></td>
<td>Pinworms</td>
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<tr>
<td></td>
<td><em>Shigella</em></td>
<td><em>Rotavirus</em></td>
<td><em>Giardia lambia</em></td>
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<td><em>Escherichia coli</em></td>
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<td>Airway</td>
<td><em>N. meningitides</em></td>
<td><em>Respiratory syncytial virus</em></td>
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<td><em>S. pyogenes</em></td>
<td><em>Varicella zoster</em></td>
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<td><em>S. pneumoniae</em></td>
<td><em>Measles</em></td>
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<td><em>Influenza</em></td>
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<td>Skin</td>
<td><em>S. pyogenes</em></td>
<td><em>Varicella zoster</em></td>
<td>Lice</td>
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<td><em>Herpes simplex</em></td>
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<td></td>
<td>Ringworm</td>
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<td>Blood, urine, saliva</td>
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<td><em>Hepatitis B and C</em></td>
<td><em>Human immunodeficiency</em></td>
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<td><em>HIV</em></td>
<td><em>Cytomegalovirus</em></td>
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**Provide safe drinking water**

Providing sufficient quantities of clean drinking water is usually the highest priority of all disaster relief efforts. Effective water purification programs will likely have a greater impact on community death and disease rates than any other single intervention. To be effective, drinking water programs must be accepted by the community, so factors such as taste and convenient access to the purified water source must be taken into account. For long-term planning, water purification programs must be sustainable by the community once the disaster is under control.

Simple field treatment of water may improve quality and decrease waterborne infections. Covering and allowing sediments to settle will improve the quality and decrease amount of chlorination needed to purify water. Sand filtration by allowing water to percolate through stones and sand contained in a 55 gallon barrel will also improve quality of water. Bulk chlorination, when available, is another way to provide clean water to large numbers of people. Reverse osmosis units, such as those used by military, can provide thousands of gallons of pure water but are expensive, require expertise to operate, and take many days to deliver to a community, costing valuable time.

The least effective means of cleaning water for consumption is relying on the individual users to do it themselves by boiling or adding chlorine to the water. Boiling takes time and effort, and using fuel resources increases environmental degradation. Cleaning water by adding bleach or chlorine at the household level relies upon motivation, efficient distribution of cleansing products, and most important, a fair amount of education provided by health care workers to do it correctly.

Utilizing an effective distribution system is equally important as having clean water. No matter the quality of water at the source, it must arrive to the end users in some fashion. Clean, covered storage tanks are a top priority as well as a means to transport the water to community members. At its most basic level, a distribution system will consist of clean receptacles for people to use to carry away water.

**Control human waste**

The crudest way to control human waste is the defecation field. These areas would ideally be segregated by sex and would be far from any water sources. Pit latrines are relatively easily constructed with hand tools and are more effective at controlling human waste than defecation fields. Locate latrines away from food and water sources, and when possible, utilize methods of fly control such as screening or covering of feces. Even the best latrines will be of little help if people choose not to use them because of lack of privacy, filthiness, or inconvenient location. It is best to use a family-cen-
tered approach to establishing pit latrines and have designated people assigned to maintain each latrine. It is recommended to assign no more than 20 people per latrine. The WHO recommends that latrines should be placed a minimum of 6 and maximum of 50 meters from dwellings. Consider implementing public education campaigns about pit latrine use and maintenance.

Take into account the special needs of children when planning for community sanitation programs. Children are more likely to defecate indiscriminately and may not use a latrine that is inconveniently located, frightening, or does not meet their physical needs. Therefore, it is necessary to provide effective health education programs specifically targeted at children and their caregivers before a disaster strikes.

Soap and water for personal hygiene are a lower priority when compared with drinking water supply and the elimination of feces. However, after drinking water requirements have been covered, it will be important to provide soap and water for personal hygiene to prevent the spread of infectious diseases. A minimum of 7 liters of water per person daily is needed for covering hygiene requirements.

Protect food supply
Developing a plan for protecting the food supply should occur in disaster preparedness. Securing community resources and safely storing and protecting emergency rations are important details to work out in advance and should include all key agencies involved with disaster planning.

Protecting food preparation from contamination is a high priority. Basic measures for preventing food-borne illness include:
- Using drinking water for food preparation
- Strict hand-washing by food handlers
- Keeping food preparation areas and utensils as clean as possible
- Control of flies and other vectors
- Proper cooking, storage, and serving techniques.

Additionally, providing health education information may be necessary to help community members prepare and use food resources safely.

Vector control
Mosquitoes can be serious sources of morbidity and mortality following a disaster. Malaria, dengue, yellow fever, and viral encephalitis can all be spread by mosquitoes. Despite the serious threat from insect-borne disease, vector control can be very complicated and require significant expertise, expense, and equipment, and therefore it may not be practical.

Basic methods of insect vector control include selecting camp areas away from insect breeding areas, eliminating breeding sites by draining swamps and disposing items that collect rainwater, applying lar-
vacides, and spraying pesticides. Personal protection such as bed nets may be helpful but require health education to maximize effectiveness.

Malaria chemoprophylaxis treatment may be implemented if public health authorities decide this is a reasonable option. A chemoprophylaxis program requires a stable population, medical support and an ongoing health education program. If unable to provide malaria prophylaxis to the entire community, a targeted program can be aimed at protecting the most vulnerable populations — pregnant women, children under 5 years of age, and malnourished children.

Provide adequate shelter
WHO recommends at least 4 square meters of floor space for each person in an emergency shelter. Shelters are more effective if they keep families and other traditional community groups together and are close to resources such as food, water, latrines, medical care, and transportation. When homes are destroyed, it is far better to locate shelters as close to or within the pre-existing community whenever possible.
THE USE OF THE SURVEILLANCE CYCLE TO GUIDE USE OF RESOURCES

OBJECTIVES

- Use the surveillance cycle to help make rational health care decisions.
- Understand the key role that primary care doctors and pediatricians play in the compilation of quality information, while simultaneously attending individual patients.
- Use this information in an appropriate way for decision making.

Surveillance cycle: A powerful public health tool

After the emergency assessment is completed and disaster recovery operations have started, ongoing surveillance is needed to evaluate emerging population needs. Surveillance is defined by the U.S. Centers for Disease Control and Prevention (CDC) as “…the ongoing, systematic collection, analysis and interpretation of public health data essential to the planning, implementation and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know. The final link is the application of these data to prevention and control. A surveillance system includes a functional capacity for data collection, analysis and dissemination linked to public health programs.”

The surveillance cycle essentially consists of gathering data that are critical for monitoring ongoing health needs, analyzing and interpreting that data in a timely fashion, providing feedback to those who need to know, and taking actions based on these data (Box 10). After an action is taken, the cycle is repeated to re-evaluate the effectiveness of this action (Figure 1).

The most important point of the surveillance cycle is making sure that data are used. Unused public health data that sit gathering dust is a waste of resources. For

<table>
<thead>
<tr>
<th>BOX 10. Important data</th>
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<tbody>
<tr>
<td>- Deaths</td>
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<tr>
<td>- Severe morbidity or diseases that are frequent in the community</td>
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<tr>
<td>- Rapid detection of selected conditions or infections, such as cholera cases, malnutrition, malaria, and severe trauma</td>
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</table>
this reason, there needs to be a clear link between data gathered by clinicians doing face-to-face consultation and policy implementation based on that data. If busy clinicians feel that keeping a patient logbook only adds more work to their day and has no impact on patient health, they will quickly stop gathering the data. This is where a breakdown between clinical and public health services frequently prevents optimal use of the surveillance cycle.

**Preventive medicine roles of pediatricians following a disaster in their community**

Pediatricians, whether in public or private service, can assist disaster recovery in their communities in many ways. These roles need not be limited to simply seeing children in consultation; with adequate preparation, pediatricians can fill many important roles, from assisting with search and rescue efforts to conducting population nutritional surveys. Their effectiveness will largely depend on personal preparation and their integration into community pre-disaster planning strategies (Box 11).

Given that children form a large proportion of the population in many countries, and because children are one of the most vulnerable groups during a disaster, it makes sense to have pediatricians serve as leaders in disaster response and preparedness programs. Drills should involve children as mock victims and should represent the ages and numbers representative of the population at large. Advance planning for meeting children’s special nutritional, psychological, and developmental needs will likely happen only if pediatricians are involved in every aspect of disaster plan-

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**BOX 11. The pediatricians’ role in preventive medicine**

- Before a disaster: not limiting themselves to direct patient care
- Evaluations after the disaster:
  - Nutritional evaluation
  - Children’s requirements
- Collaboration in disease surveillance:
  - Design of surveillance systems, keeping children in mind
  - Collaboration in the collection and analysis of data

Drills should involve children as mock victims and should represent the ages and numbers that are representative of the population at large.
ning. By teaching other health workers, such as nurses, general practice doctors, and lay community health workers, pediatricians can disseminate their knowledge of children’s special needs throughout the disaster response community.

Pediatricians in private practice may need to go out of their way to meet with public health, military, and other governmental officials to offer their services in pre-disaster planning. Waiting to act “ad hoc” after a disaster strikes is a recipe for wasted effort and represents an inability to make a meaningful impact on community recovery. Benjamin Franklin has said that “failure to plan is planning to fail.”

Even if pediatricians work primarily in their traditional capacity of clinical consultation, they may still have a significant role to play in preventive medicine by making sure that a functioning surveillance cycle is in place. Crucial points of the cycle would include establishing an adequate patient logbook that captures important disease data and stratifies data to specific age and sex groups. This is where the surveillance cycle begins, with clinicians seeing individual patients. If they do not capture these data, public health decisions will be based on speculation, not facts.

Next, pediatricians can ensure that individual patient data are shared with public health authorities in a timely fashion, which will allow analysis and quick response to rapidly emerging public health needs. Pediatricians who handle their own preliminary data analysis by reviewing patient logbooks on a daily basis and looking at disease incidence data in terms of rates will allow quicker and more effective interventions and recommendations for resource allocation. Finally, by developing and maintaining effective communication with public health leaders, pediatricians can ensure that wise decisions are made regarding the care of children in their communities.
SUMMARY

Pediatricians have much to offer their communities in disaster preparedness and response. Knowledge of children’s medical needs and a natural tendency to be advocates for children are pediatricians’ greatest assets. After a disaster, basic preventive medicine and public health is generally a higher priority than providing clinical consultation for individual patients, and this will help increase pediatricians’ ability to effectively respond to a disaster in their community.

Good preventive medicine techniques involve thorough population evaluation and needs assessments, and using these data to guide initial disaster response. Setting up a functional surveillance system will help evaluate the adequacy of disaster response interventions and will alert clinicians and public health officials to emerging threats to community health. Gathering and using data to intervene at the community level will help ensure the best possible outcomes for entire communities when a disaster strikes.

SUGGESTED READING


Case resolution

1. The situation described in the case presentation can be considered an epidemic, taking into account the number of cases observed in the club, which would not to be expected. It is important to remember that an epidemic is defined as an increase in the number of cases at a given time and in a given place, as compared with those observed at the same time and place in previous years.

2. Diseases that can be considered in the differential diagnosis of an outbreak of acute gastroenteritis include:
   • Bacterial: *Salmonella typhi*, *Shigella*, *Staphylococcus aureus* (toxin)
   • Viral: Rotavirus

3. Incubation times associated with the different potential etiologic agents vary. Therefore, the estimation of the time interval between food ingestion and the onset of symptoms may help identify the probable etiology of this epidemic outbreak.

4. The likely vehicle is one of the foods ingested during dinner.

5. It would be appropriate to culture fecal samples from the individuals responsible for the preparation and distribution of meals, as well as from the sites in which meals were prepared and stored. It would also be adequate to obtain samples for culture from meals served during dinner, if available if they have been stored or not yet eliminated.

6. Implement strict hygiene measures in the club kitchen, and insist on careful hand washing by the persons responsible for the preparation of meals. If a carrier of one of the potential etiologic agents of the described outbreak is identified, isolate the carrier until the pathogen is eradicated.
MODULE REVIEW

SECTION I – GATHERING AND USING POPULATION STATISTICAL DATA

1. How can preventive medicine be characterized?
2. How is a rate defined? What purposes can rates serve?
3. What is an epidemic?
4. What factors should be taken into account for the control of an outbreak?

SECTION II - POPULATION HEALTH EVALUATIONS INCLUDING EMERGENCY NEEDS ASSESSMENTS

1. What are the principal factors used to evaluate a population?
2. How are demographic data obtained?
3. What is the best source of data to determine the health conditions of a population before a disaster?
4. What are the key factors for assessing requirements during an emergency?
5. How are health care resources evaluated?

SECTION III - POST-DISASTER INTERVENTION PRIORITIES

1. What are the primary modes of transmission of diseases?
2. What are the most frequent sources of disease transmission?
3. What disease conditions frequently occur during a disaster?
4. What are the public health priorities after a disaster?
5. What are the post-disaster circumstances in which immunization is recommended?

SECTION IV - THE USE OF THE SURVEILLANCE CYCLE TO GUIDE USE OF RESOURCES

1. What components of the surveillance cycle are crucial for its effective implementation?
2. What role do pediatricians play in preventive medicine?
APPENDIX

60

Y

Y

Y

Y

Y

Y

Y

Fruit salad

Y

Chocolate ice-cream

Y

Y

Vanilla ice-cream

Y

Y

Cakes

Y

Y

Water

Y

Y

Coffee

Y

Milk

Y

White bread

Y

Day

Whole wheat bread

Purée

Y

Ill

Squash

Spinach

No.

Time of
food
Age Gender ingestion

Boiled ham

Onset of
symptoms

Jelly

Information for the case resolution:
Time of symptom onset and food ingestion by the individuals
who developed gastroenteritis

Time

Y

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### Food eaten by the individuals who did not develop gastroenteritis

<table>
<thead>
<tr>
<th>No.</th>
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<th>Time of food ingestion</th>
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<td></td>
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<td></td>
<td>boil</td>
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Planning and Triage
in the Disaster Scenario

Ciro Ugarte | Jacobo A. Tieffenberg | Lou E. Romig
INTRODUCTION

“Failure to plan is planning to fail.” This quote by Benjamin Franklin appropriately reflects the message of this module. Emergency preparedness planning is crucial to prevent or mitigate a disaster. As defined in Module 1, disasters occur when a natural or man-made event transforms a vulnerable human condition into a disaster; needs exceed the local capacity for response. Without adequate planning, the most common response to these types of incidents is confined to simply rescuing victims to transfer them as soon as possible to a hospital facility (the “Scoop and Run” approach). This results in the transfer of the problem from the incident site to the hospital, overwhelming and disrupting the care capacity of the health facility.

Some events occur suddenly, with little or no warning. Others, such as floods and hurricanes, usually provide advanced warning or have a gradual onset that allows for additional preparations before the critical stage ensues. In any case, specific planning and preparedness are especially important to reduce the suffering caused by disasters, particularly for children. Children are among the most vulnerable populations in disasters, and because they have unique physiological, psychological, and developmental needs, pediatricians and the local community have a special responsibility to assess how local, regional, and national preparedness plans and response systems will actually function to protect children. To fail to consider the needs of children in disaster planning, preparedness, and response at all levels is to potentially jeopardize one of our more precious
resources. Pediatricians must advocate for the health, safety, and well-being of infants, children, adolescents, and young adults who cannot advocate for themselves. It is important to increase our knowledge and understanding of how children were affected by past disasters so that we can strengthen our response.

The information provided in this module can assist in the design of an emergency preparedness plan that will increase coordination among the many disciplines involved in disaster response. Active participation of all relevant entities in the development of the plan is crucial.

Participation must break down the silos that all too often isolate different disciplines and should promote understanding and cooperation among them. The multidisciplinary inclusive planning process is actually more important than the document itself. The planning process facilitates a collective understanding among all the key agencies and their personnel about the plan. This is indispensable for effective implementation of the plan when it is needed.

Planning should include both short-term and more long-term ways of reducing the risk from events that cause disasters, efforts to educate families and community organizations about preparedness, and the methods of horizontal and vertical coordination involving multiple local disciplines as well as regional, national, and international assistance networks. Local planners need to have knowledge of the regional and national response systems and the means to coordinate local activities with these systems.

This module reviews the basic concepts for emergency planning and response preparedness and the various levels that need to have a plan, including the family, health professionals, community organizations, and health facilities and hospitals. The final section of this module reviews how to organize community emergency services that will be capable of responding to a mass casualty incident.
medical and humanitarian assistance. Afterward, efforts will be directed towards rehabilitation, which means provisionally repairing the damaged services. Reconstruction consists of completely restoring the goods and services back to the levels prior to the disaster, and includes measures for risk reduction.

Disaster management is part of the social system responsible for planning, organizing, directing, and controlling during all the phases and stages in the cycle of adverse events.

The plan defines the purpose, objectives, strategies, and activities that will help to achieve it. The products of planning are the plan, the chronology of activities, and the budget.

The plan will have different purposes depending on the stage in the cycle of adverse events. During the stage of prevention, the ultimate goal is to avoid or minimize the disaster. Therefore, during the mitigation phase, efforts aim at reducing both the risk and the vulnerability. The remaining risk implies that damages will occur. To face these damages, the capacity for response must be improved through preparedness. If a disaster occurs, the plan will be implemented in order to provide

Disaster preparedness includes the design of the plan, the training of those persons that will execute it, and the availability of the needed resources. The plan designed during this stage is generically named the response plan. A plan made for various adverse events is called an emergency or disaster plan, whereas a contingency plan is designed for a specific adverse event (e.g., hurricane).

Pediatricians act, initially, as risk management agents in the local emergency and disaster system and, if a disaster occurs, as specialists in the care of children. They should be familiar with the plans that exist in their town or district so that they can work in coordination with other members of the response system.

In summary, planning includes all the activities and actions taken in advance in order to mitigate, minimize, or prevent the damages that disasters can cause. All the stages of a disaster (described in Module 1) include elements of planning that are important for the pediatrician. These involve various social agents and are performed at different levels:
the family, the emergency services, the community physicians, the hospitals, the government, the local community organizations, and other agencies.

If a response plan has not been developed or fails to contemplate the special needs of children, develop a plan, or suggest additions to the existing plan. This is not merely desk work. It involves obtaining and analyzing data, along with field visits and meetings with representatives from different institutions and the community. Preparation demands the active participation of the health care sector and the community. These efforts should result in the production of operative and concise documents that clearly define the responsibilities of specific participants and the agreements reached among the participants. Institute periodic drills to test the functioning of the system and the coordination among the different participants.

**Risk evaluation**

A risk evaluation involves an analysis of threat and vulnerability. It considers the characteristics of potential threats to a community and determines how the community would be affected. It is important to identify the possible natural events (e.g., earthquakes, torrential rains, volcanic eruptions, sliding soils, the overflow of rivers or lakes). In certain regions, the climatic events that endanger the population have a seasonal predisposition. Therefore, recognize these climatic cycles in order to maximize the precautions taken before and during these periods. Do not disregard disasters caused by human actions. These include incidents in factories, chemical or fuel storage plants, intentional or accidental fires, incidents with radioactive or nuclear materials, armed conflicts, wars, or terrorism.

Identify regions and communities that are most vulnerable to the threats under consideration. Describe the specific characteristics that make these communities susceptible to those threats, in order to through preparation.

**The community – local emergency plan**

Every community should develop its own emergency plan with the participation of the local institutions and social agencies. Clearly define the responsibilities of each institution and methods of coordination and collaboration. Analyze the risks threatening the different sectors of the community and develop immediate interventions recognizing both geographic and climatic conditions for various regions. Obtain input from regional and national levels, involving national and regional health officers in the planning process.

**Key planning concepts**

In general terms, the plan describes in a clear, concise, and complete manner the responsibilities of each participant, the risks, and the range of interventions. For a health care agency, the emergency plan defines the objectives, the actions, and the organization of the hospital and its various departments with respect to the response activities and responsibilities of the staff members.

The emergency plan should fulfill three essential characteristics: it should be clear, concise and complete:

- **Clear**: make the wording simple and easy to understand, with no margin for doubt.
- **Concise**: be able to read the plan quickly. The longer the plan, the less likely it will be read in its entirety and the more difficult it will be to update regularly and distribute.
**Complete**: include all the necessary components for effective action, coordination, and reassessment.

Additionally, the plan needs to be known. This is essential if the plan is to be executed in the pre-established manner.

It also is essential to involve in the planning process the organizations that will carry out the plan. This inclusive planning process is as important as the quality of the final plan itself.

**Basic components of an emergency plan**

**Analysis of the situation**

The analysis of the situation includes:

- a description of the threats, whether naturally occurring or due to a human action.
- an analysis of the structural and non-structural vulnerability of areas at risk in the community.
- an evaluation of how agencies would function to deliver needed services, i.e., operative capacity.
- the availability of resources, infrastructure, equipment, and critical supplies.

**Assumptions**

Identify the type or types of phenomenon that should be addressed in the plan and describe its probable magnitude, the expected intensity at the site where the community is located, and the time period during which it is likely to occur. Determine the potential damages and the maximal demand for health services by establishing a relationship between the threat and the vulnerability.

**Objectives and goals**

The objectives and goals describe the expected outcomes from executing the emergency plan, given the human, economic, and material resources that will realistically be available. One of the most frequent mistakes when preparing an emergency plan is to include nonexistent resources with the hope of obtaining them in the near future. Since it is usually impossible to obtain all the desired resources, establish priorities for the actions based on the population and geographical area to be served. The plan should include an outcome prediction that describes the measurable impact of carrying out the emergency plan.

**Organization**

Organize the various sectors and departments of the institution so that authority, lines of responsibility, and methods of coordination and communication (especially for activating the plan) are clear and well defined. Establish an emergency operations committee to oversee and coordinate the response actions.

**Roles and responsibilities**

The assignment of roles and responsibilities is meant to answer the following questions:

- Who does what?
- When?
- How?
- With what?

**Communication and coordination**

The communication instructions describe a calling or notification chain from a central point until all the necessary individuals have been contacted. Establish the means of communication to be used, indicating the radio band and frequency, the telephone numbers, and the sites to which people should come. Appendices to the plan include an updated directory of all the participants, a map of...
threats, vulnerable areas, or locations, as well as the population database, a health profile, health centers included in the network, a directory of basic services (e.g., water, electricity, telecommunications, safety), assistance agencies, and an inventory of the available resources.

Training
Once the emergency plan has been developed, conduct training. Training should enable the participants to describe the situation, the most probable damages, roles and responsibilities, and the coordination instructions. This training should include simulation exercises consisting of a written test based on the presentation of scenarios. The participants will have to solve theoretical exercises once they have been assigned one of the roles and responsibilities contemplated in the plan. This exercise allows participants to assess the degree of their knowledge of the technical and organizational aspects of the emergency plan.

At a later stage, disaster drills can be organized and enacted. Early in the training, organize disaster drills with prior notice, promoting the participation of the staff and key members of the community. Once the participants have acquired sufficient knowledge and skills, organize unannounced disaster drills to put the response plan to test. Enacting unannounced simulated disasters without previously training participants usually causes frustration and has unwanted effects.

Resources
Analyze the activities included in the emergency plan to determine the resources required. This listing of resources is called the requisite analysis. Contrast the listed resources with those actually available and define the resources that are yet to be obtained. Gather the resources needed to carry out the emergency plan. It is important to remember that the emergency plan must be based on reality. Otherwise, it will become a mere listing of wishful ideas. The Humanitarian Supply Administration System (Sistema de Administración de Suministros Humanitarios, SUMA) is a useful tool designed by Pan American Health Organization: a software presenting the integral management of humanitarian supplies.

Coordination of the local emergency plan
The response mechanisms will have specific characteristics depending on the size of each community and the particular risks that threaten it. The coordinators in hospitals, rescue services, and emergency medical services, as well as the participants processing the incoming information, should report to a general coordinator of the local plan. This individual is usually not the coordinator of the emergency command post.

The general coordinator of the local plan is a professional member of the community holding a high-ranking position who has been appropriately trained in the coordination of emergency and has participated in the development of the local plan. This coordinator’s most important functions include: 1) verifying the appropriate implementation of the plan consistent with the specified conditions and in the appropriate periods of time, 2) coordinating internally the health care efforts through meetings with the coordinators of the different areas, and 3) informing the higher-level health authorities and requesting the necessary resources.
PLANNING LEVELS

OBJECTIVES

- Identify the different levels of planning for disasters.
- Help families make a family emergency plan.
- Recognize the importance of one’s own planning, and the planning by other health care professionals and health centers.
- Identify those activities that can be incorporated in schools to help protect children.
- Identify the special needs that should be addressed in a disaster shelter.

Planning in the family

Pediatricians should prepare themselves for a disaster as well as provide the families of their patients with information about creating a family emergency plan. The questions below serve as a planning guide. Families need to understand that they have to be prepared to evacuate before the area becomes inaccessible by the rescue services, and if they stay, they might not be immediately helped.

- What are the disasters most likely to occur in your community?
- Are your home, your children’s school, and your working place located in risk areas?

- How well-prepared is your home to face the most likely disaster?
- Can your family be notified with sufficient anticipation or should they be prepared to respond at any time?
- In the event of a disaster, can you locate and reunite your family members in a safe place?

All family members should know contact telephone numbers outside the affected area and know where community shelters will be located. It is also a good idea to establish a meeting point outside the risk area when possible.

- What should you do when you or one of your family members needs to leave the family because of health care or other related responsibilities during a disaster situation?

When professional duties (e.g., those of health care professionals, policemen, firefighters, public officials) limit the ability to assist one’s own family, it is important to have a clear written plan that has been discussed and can be followed.

- Do any members of your family have special health needs that will require medication or treatments that might be affected during a disaster?

Consider storing and periodically renewing medications and supplies needed by family members with special health care needs for use in the event of a disaster. Consider having a small backup generator to keep a refrigerator operational to

Pediatricians should prepare themselves for a disaster as well as provide the families of their patients with information about creating a family emergency plan.
store medications when there is no electricity. Recognize that family members with special needs may require earlier evacuation to a shelter that can provide a safer environment.

Provide families with information about making a contingency plan that will ensure family independence for the 3 days following a disaster. A list of supplies needed to be self-sufficient for 3 days are shown in Box 1. A local specialist can add other useful supplies based on the local situation. Box 2 lists online resources for families.

**Planning by the medical staff**

In addition to having their own family plan and educating the families of their patients, pediatricians should address several issues for their offices and staff. These issues involve ensuring the safety of staff and patients, protecting equipment and material, and securing patient records.

### BOX 1. Supplies needed for self-sufficiency for 3 days

#### Basic supplies
- Bottled drinking water (4 L/d/person)*
- Identity cards of all family members
- Well-equipped first aid kit
- Food
- Matches
- Flashlight with batteries
- Extra clothing for protection from bad weather or outdoor stays
- Blankets or sleeping bags
- Money, including small change
- Insect repellent
- Elements for personal hygiene
- Various supplies for infants and small children
- First aid manual
- Portable radio, cell phones (preferably with radio or walkie-talkies)
- Map of the city or region
- Frequently used medications and medical prescriptions

#### Some complementary supplies
- Manual can opener
- Two extra sets of home and car keys
- Elements to hold and transport pets (e.g., leashes, collars, kennels)
- Food and water for pets
- Extra glasses

* It is advisable to have enough drinking water for 1 week.
Consider the need to have a backup generator to maintain refrigeration for vaccines and other medications. When necessary, plan for a backup location for treating your patients and, if possible, a method for informing callers where they can obtain care.

**Planning by schools**

Public and private schools also need emergency response plans. School plans should consider the most frequent accidents as well as unusual situations (e.g., fires, school violence, kidnapping of a student, terrorist attacks, community violence). School plans should include details on how urgent medical care can be provided when needed on site. Plans should include training for school staff in basic life support, first aid, and rescue techniques.

School disaster plans should also address the identification and management of post-traumatic stress in students and staff members, as well as indications for referral for psychological intervention. Following a disaster, children often need the security of a normal routine and support of teachers and peers. Closing schools for a prolonged period negatively impacts the functioning of children after a disaster. Every effort should be made to open schools as soon as possible after an event. One limiting factor to reopening schools is their use as emergency shelters for a prolonged period of time. This is usually done in coordination with other agencies that provide food and shelter.
such as the Red Cross or the local organization for emergency management.

Child care centers also need a plan to ensure the safety of the children, coordinate with other community response agencies, and provide a method for reuniting children with family members. Child care centers need to educate and train staff members to implement the emergency plan efficiently.

Families, schools, and child care centers must consider how to help children with special health care needs in an emergency situation. The AAP and the American College of Emergency Physicians have published an emergency information form (EIF) for children with special needs. This document (Available at http://www.aap.org/advocacy/blankform.pdf) provides important medical information about the child to any person responsible for the emergency medical care.

**Medical planning for shelters**

Shelters should have an identifiable person who is available, accountable, and responsible for communicating with agencies or organizations for supplies and assistance. Planning for shelters must consider the possibility of prolonged use that would require additional supplies and greater attention to organizational details. Planning should include sources of supply and methods of transportation. The needs of pregnant women, infants, and young children must be considered with respect to formula, diapers, basic first aid kits, and hygiene as well as safety. Shelters also must consider children with special health care needs. For example, children with asthma may need nebulizer treatments. Although their families are likely to have brought their own nebulizers, a source of electricity is needed for these devices to operate. Similarly, a refrigerator is required to store insulin for children and adults who have diabetes. Families with very young or debilitated children may move temporarily to a shelter to protect them from the heat, cold, sun, wind, or rain. Whenever possible, shelter staff members should have direct telephone or radio access to emergency medical care services to obtain medical advice. Ideally, a shelter should have isolation protocols for highly contagious infections such as measles and chickenpox.

Shelter life must also be organized so that children are supervised and have the opportunity for constructive play and entertainment. Supervised activities enable the staff to inform children and calm them down while allowing them to participate in family activities and tasks. Drawing and other creative activities can help children to express themselves and reduce the stress. Adolescent activities are also important to keep energy channeled constructively and reduce the potential of adolescent violence.

Safety in shelters is as important as safety at home. Keep drugs, medical supplies, and potentially dangerous personal items out of children’s reach.

**Planning by hospitals**

If you work regularly at a hospital, review the hospital disaster plan to ensure that the plan adequately considers the needs
of children. If your hospital lacks an emergency plan, offer to help develop a plan. Materials are available through the World Health Organization (WHO) and the Pan American Health Organization (PAHO) about creating a plan that includes an instructor manual, a participant manual, reference documents, presentations, and evaluations. These are available at www.disaster-info.net/planeamiento.

Hospital planning for disasters should deal with hospital and pre-hospital events. Hospital events include accidental or non-accidental events such as the collapse of hospital structures, fires, explosions, or contamination with dangerous substances. Plans should include a detailed description of the measures to be taken to protect staff members, visitors, and patients. Rescue interventions attempted by hospital staff who have received no previous training can put them in serious danger. Educate staff about basic safety precautions and knowing when it is safer not to intervene but wait for the arrival of trained rescue workers. During the past 25 years natural disasters have destroyed dozens of hospitals and hundreds of health centers, resulting in the deaths of thousands of patients, physicians, nurses, and other people who were trapped in the debris.

The detailed field plan for pre-hospital responses recognizes that it is likely that there will be a sudden increase in the number of patients. Given that the focus will be on caring for the sudden influx of patients, it is important to ensure that the existing inpatients also receive appropriate care and are discharged or transferred to other facilities. The plan should include a communication method to call in additional health care professionals. Hospital directors and heads of the emergency departments should have a basic knowledge of the local disaster plans and the local command lev-

CASE 1
A shelter with 130 evacuates is severely damaged by a tornado during a storm. According to the local protocol, emergency medical services cannot reach the place due to the intensity of the storm. Victims of the tornado, both adults and children, begin to arrive massively to the nearest hospital emergency department. Referrals to other hospitals are not feasible because of the storm.

- Does your hospital disaster plan take into account victims arriving on their own, or does it only consider those transported by the emergency medical services?
- Are emergency department staff members prepared to perform a primary triage of the victims?
- Does your hospital disaster plan take into account the staffing and resources needed for the emergency medical services to operate under highly demanding conditions with minimal external help?
els. Select one or more members of the hospital staff to serve as a liaison with other responding organizations and agencies. It is vital to coordinate any activities undertaken outside the hospital environment with community emergency services. In certain situations a hospital can also serve as shelter for staff members and their families, patients with special needs, and the general public.

Some U.S. hospitals are adopting a modified command system in case of accidents. This Hospital Emergency Incidents Command System (HEICS), developed in California, allows for a greater integration with the external response plans (Figure 1 and Box 3). The next section of this module provides a more comprehensive review of how to deliver medical services and implement a triage system for children.

Hospitals can also offer physicians who have lost their offices a space in which to attend to patients. These physicians, in turn, can cooperate with the regular hospital physicians in the care of patients who have with minor conditions, thereby allowing them to attend to more critical cases.

Hospital plans also need to contemplate the management of individuals with acute stress, those who feel guilty for having survived or having abandoned their families, and those who have suffered considerable material losses or have other psychological consequences of the disaster. Post-traumatic stress disorder and other stress-related syndromes are relatively frequent after a disaster. These disturbances can affect members of the hospital staff, resulting in an overall depressive atmosphere that interferes with an efficient performance.

In Latin America and the Caribbean, for the past 20 years hospital plans have been developed based on PAHO guidelines. In many countries, these guidelines have been adapted to each country’s own reality, including mechanisms for monitoring and assessing the degree of preparedness of their hospitals. These technical publications and guidelines have been structured and offered by PAHO, using interactive teaching methods. This material is currently available in CD-ROMs and on the Internet.
FIGURE 1. HEICS structure

Box 3. HEICS

HEICS (Hospital Emergency Incident Command System) was created in 1993 in California by the authorities of San Mateo district medical emergencies service (MES). It consists in an algorithm of positions, the holders of which have a specific task in the event of an emergency situation (Figure 1). Each of these persons has his/her own listing of tasks to be carried out, so that he/she can guide the implementation of these tasks in the framework of an integral system if a disaster occurs. HEICS also includes listings of operations aimed at maximizing the overall efficiency, promoting the undertaking of responsibilities, and facilitating the recording of key data. This system has a flexible structure, allowing the activation of the required positions only, since activating the entire structure may take hours and even days. In the vast majority of cases, less than the complete structure will be needed. The listed positions are not assigned to a specific individual; several individuals may be suitable for covering a position assigned by the incident coordinator; in other cases, a single individual has to undertake more than one position, according to the listing of tasks.

Additional information on HEICS and its materials can be obtained at www.heics.com.
MASS CASUALTY MANAGEMENT AND MEDICAL CARE

OBJECTIVES

- Learn the basic components of a mass casualty management approach.
- Differentiate the various roles of the individuals providing assistance during a disaster.
- Be familiar with the rescue chain steps from the incident site to the hospital.
- Understand the importance of patient documentation and recording.
- Understand and apply the triage algorithms.
- Identify the differences between the adult and pediatric triage algorithms (START and JumpSTART).
- Identify the tasks of a mass casualty management approach in humanitarian emergencies.
- Be familiar with the planning tasks during the mitigation phase.

CASE 2

A school bus with primary school students and caregivers leaves for a drive into the countryside, but skids on a sinuous stretch of the road and overturns. The vehicle is seriously damaged. Several children and adults manage to escape, other children fall from the track, and many remain trapped inside. Children are screaming and crying.

- Are emergency medical care agencies in your district prepared for the rescue, triage, management, and transport of a large number of severely injured children?
- Which of the local hospitals is prepared to provide care to severely injured children?
- Is the nearest trauma center prepared to treat so many patients?
- Will some of the local pediatric emergency departments be able to collaborate in the management of some of the less seriously injured victims?

Medical care in a mass casualty incident (MCI)

Mass casualty management, as may occur in a disaster situation, requires an adjustment of the traditional emergency care approach. In the traditional care approach,
first responders are trained to provide victims with basic triage and health care before evacuation to the nearest available receiving health care facility. This approach juxtaposes two organizations that work independently with only weak linkages: the field (often involving non-health sector responders), and the receiving health care organization that is often totally divorced from the pre-hospital problem. In a mass casualty situation, this approach will quickly result in chaos.

For this reason, a system that would allow an adequate response to mass casualty situations was developed. This system, known as mass casualty management, includes pre-established procedures for resource mobilization, field management, and hospital reception. It is based on specific training of various levels of responders and incorporates links between field and health care facilities through a command post. It acknowledges the need for a multi-sector response for triage, field stabilization, and evacuation to adapted health care facilities. The development of this approach is based on the availability of large amounts of human and material resources, so it should be adapted to the available resources to maintain the same effectiveness in its implementation.

The mass casualty management system is based on:
• Pre-established procedures to be used in daily emergency activities and adapted to meet demands of a major incident
• Maximization of the use of existing resources
• Multi-sector preparation and response
• Strong pre-planned and tested coordination

This system is developed to:
• Accelerate and amplify daily procedures to maximize the use of the existing resources
• Establish a coordinated multi-sector rescue chain
• Promptly and efficiently bring disrupted emergency and health care services back to routine operations.

The rescue chain, the essence of the mass casualty management system, involves the health department, private hospitals, police, fire department, non governmental organizations (NGOs), transport services, and communications (Figure 2). This chain starts at the disaster site (with activities such as initial assessment, command and control, search and rescue, field care), continues with transfer of victims to adapted facilities (using procedures to regulate evacuation and ambulance traffic control), passes through hospital reception (with activation of the hospital disaster response plan), and ends only when the victims have received all emergency care needed to stabilize them.

The implementation of this rescue chain requires the following components:
• An efficient accident and emergency department
• A basic radio communications network
• Coordination procedures among all sectors involved
Skilled multi-sector rescue teams

As in any chain, the strength and reliability of the system depends on each link; if one fails, the entire system will be compromised.

The assignment and organization of resources in mass casualty management requires careful planning.

Activities at the site of the disaster

These activities include the procedures needed to organize the disaster zone. The alert given by any observer sets the process into motion. Define precisely the location of the disaster event, the time of its occurrence, its type, the estimated number of victims, the risks, and the population threatened by these risks. The initial assessment will establish what resources will be mobilized to the site of the disaster (Figure 3). The initial evaluation unit identifies the zones to be set up at the incident site:

- Impact zone
- Incident command post
- Advanced medical post
- Evacuation area
- Authorities and press
- Roads of access
- Restricted areas

Safety

Rescue activities during a disaster should include measures to guarantee the safety of the victims, the members of the rescue units, and the general population (Figures 4 and 5).

Communication and documentation

When a disaster occurs, both landline telephones and cell phones could be overburdened. The communication systems of

**FIGURE 2.** A multi-sector rescue chain

Patient referral information should be provided from the site to the Incident Command and from there to intervening agencies and the nearest hospital.

choice for the emergency units are the ultra-high frequency (UHF) and very high frequency (VHF) waves. The former are used for communications within the area of the event, and the latter for communications with strategic centers for purposes of coordination or transportation. Patient referral information should be provided from the site to the Incident Command and from there to intervening agencies and the nearest hospital. Essential information to be collected includes:

- Number of victims
- Number of persons who need to be transferred to a hospital
- When and how they will be transported
- Relevant lesions

**Care of victims**

Search and rescue activities should be performed by individuals with specific capabilities including firefighters and specialized units. Before allowing these individuals to enter the disaster area, verify whether they need special clothing or breathing equipment to protect them from environmental risks.

Once the search and rescue units have located the victims, they must take them...
FIGURE 4. Organization of the impact zone after a road traffic accident


FIGURE 5. Organization of the impact zone after a leakage of toxic debris

to a risk-free collecting point to be assessed (field triage).

After this initial evaluation, the victims receive first aid according to status and will be transported to the advanced medical post, if necessary. When the number of victims or the distance from the place of the incident prevents the direct transportation of patients to the hospitals, an advanced emergency care field hospital may be established adjacent but outside the incident site.

In the advanced medical post all the admitted victims are medically triaged (see "Triage: Rationale" below), to identify those who require immediate care. Following triage classification, victims are referred to the adjacent treatment areas, where they are stabilized. Stabilization procedures include intubation, tracheostomy, fluid therapy to maintain circulation and treat shock, and analgesics. Document the therapy that will go into the evacuation patient report to the hospital. The medical post staff members triage and stabilize the patients, reassess their condition, and organize their transportation to the appropriate hospitals. All these tasks have been summarized as the 3 Ts principle: typifying (classifying), treating, and transporting.

The advanced medical post should be staffed with trained emergency department physicians and nurses, with additional physicians, surgeons, anesthesiologists, and nurses being added if available and needed.

Triage: Rationale
Triage is a system that allows establishing priorities for the care usually provided in situ. It is performed during the rescue phase, and uses priority criteria for the care of patients, distinguishing those requiring immediate stabilization and transport from those who can wait. In a more detailed analysis, triage also allows for identifying patients who need emergency surgery. The primary triage in an MCI consists of a quick evaluation so that all the victims can be examined in a short period of time and decisions can be made regarding saving lives. Once the perimeter of the restricted access zone has been defined, the staff responsible for triage refrains from providing the victims any type of treatment (not even cardiopulmonary resuscitation, mechanical ventilation, or airway management) until completing the primary triage of all victims. During this evaluation, attach a tag with an encoded color to each victim indicate to the health care provider what type of attention is needed. Primary triage is based on the premise that all the victims are equally important, regardless of age, gender, profession, or any other factor. Decisions are made exclusively based on the victim’s clinical condition. Patients are classified according to severity in Green (uninjured), Yellow, Red, and Black (deceased).

Field triage is performed on three levels:

Onsite triage: Classifies the victims to identify those who need to be taken immediately to the advanced medical post. First aid providers or medical emergency technicians usually do this onsite triage. When the technicians do not have extensive experience in onsite triage, consider having them classify together the victims in the "yellow" and "red" groups, as opposed to those in the "green" group. Using this approach, the percentage of incorrect classifications declines significantly. In addition, this sim-
plified classification results in a reduction of the time required for the initial evaluation.

**Medical triage:** Determines the required level of care.

An emergency physician, anesthesiologist, or surgeon should be in charge of this type of triage.

**Medical triage classification**

**Red:** Immediate stabilization is required. This applies to victims who have:
- Shock due to any cause
- Breathing difficulty with possible respiratory failure
- Profuse external bleeding
- Head trauma with signs of altered consciousness, such as:
  - disorientation (can not obey simple commands)
  - unconsciousness (can not respond to verbal and/or painful stimuli)
  - asymmetrical pupils (sign of cerebral hernia)

Stabilize these patients so they can receive further care. After stabilization, reclassify.

**Green:** These victims can wait or do not require treatment. This category includes those who have:
- Minor fractures
- Minor wounds or burns

After onsite care has been completed, take those victims who have been classified as yellow or red to a hospital. They will be subject to triage on arrival.

**Black:** Deceased.

**Evacuation triage:** It is intended to classify the victims in terms of their priority for transportation to the nearest hospital:

**Red:** These victims need transportation as soon as possible in an ambulance with a specialized crew to a tertiary hospital because they:
- Require surgery for survival, or organ-function preservation
- Need ICU services

**Yellow:** After all the red code victims have been evacuated, transport these victims in an ambulance to a tertiary care hospital. This includes persons who are under observation for potentially fatal problems and may require hospital care.

**Green:** These victims may be discharged onsite, if possible, after being checked and reassured. Those with minor wounds or burns should be treated or sent to a primary care facility if available.

**Black:** Transportation to the morgue.
SECTION III: MASS CASUALTY MANAGEMENT AND MEDICAL CARE

Children’s triage
The JumpStart pediatric triage system uses a decision-making process based on physiological criteria adapted to the normal range of pediatric values (Figure 6).

The system also includes other evaluation standards that recognize an apneic child still maintains a certain degree of skin perfusion before he/she develops an irreversible cardiac lesion secondary to anoxia. These children can survive if their respiratory function is sustained or restored, something that will not be identified by applying the START system (Figure 7), which does not include pulse palpation for patients whose apnea persists after the airway has been opened. Children that are not able to walk or are carried in arms by adults should always be categorized at least as yellow.

Regardless of the triage system used, perform a careful secondary evaluation on all the victims onsite and then again at the emergency department.

Adapted from Dieckmann, RA. Pediatric Education for Prehospital Professionals. EE.UU.: Jones and Bartlett, 2006:180.
is offered definitive evaluation and treatment.

**Transfer organization**

The transfer organization includes those procedures implemented to ensure that victims of a mass casualty incident will be safely, quickly, and efficiently transferred by appropriate vehicles to a prepared health care facility.

Transfer is organized according to different principles such as strict control of the rate and destination of evacuation to avoid overwhelming the health care facilities. One of the roles of the first responding team arriving on the scene is to stop spontaneous evacuation organized by witnesses. This unmanaged transport is unsafe; uncontrolled conditions sent to any unprepared health care facility will endanger the lives of victims and disrupt the implementation of the mass casualty management system, thus endangering the lives of those to follow.

No victim may be removed from the advanced medical post to health care facilities before:

- The victim is in the most stable possible condition.
- The victim is adequately equipped for the transfer.
- The receiving health care facility is correctly informed and ready to receive the patient.

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**FIGURE 7.** START triage


CR = capillary refill
- The best possible vehicle and escort are available.

Control of victim flow: The Noria principle

Patient movement (whether by walking, by stretcher, by vehicle) must be in a "one-way" direction and without any crossing. From the impact zone to the collecting point, from the collecting point to the advanced medical post entrance, and subsequently to areas of treatment, evacuation, and hospital care, the victims will be on a kind of one-way "conveyor belt," taken from a basic first aid care level to sophisticated care level (Figure 8).

Organization of hospitals

The mass casualty management system needs a specific organization at the hospital that will receive them. This system allows the active mobilization and management of the available resources, facilitates the links with the pre-hospital structures, and improves the management of the inpatients and the flow of victims. Additionally, it facilitates care management, secondary evacuations, and the process of informing the authorities and the victims’ families.

Certain key departments, including the emergency and surgery departments, the operating rooms, laboratory, radiology department, and intensive care unit, have to be reinforced. It is also important to prepare sequential reinforcements and allow a rapid rotation of the staff in those areas where the demand is greatest. This prevents overburdening the staff during the care of a massive number of victims and ensures the prompt return to the regular activities with an adequate staff.

As part of the coordinated efforts the security at the hospital should be reinforced with police officers stationed at the

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**FIGURE 8. Victims flow: the Noria principle**

This one-way progression from level to level by rotating transportation resources was labeled “Noria” in 1916 during the World War I battle of Chemin de Dames in Verdun, France. "Noria" comes from the Latin word for "wheel." From: Establishing a Mass Casualty Management System, Washington D.C., 1996.
gates and in the reception area. In every hospital there should be a room equipped with a radio and telephone. This room is to be used as the command post in emergency situations.

Reception of victims
In order to have more hospital beds available to receive the MCI victims, discharge all patients that could be cared for on an outpatient basis.

In case the pre-hospital management fails and victims arrive at the hospital with no previous control, after triage these victims should remain in an adjacent ward where they can be controlled and stabilized before being transferred. The triage officer can confirm or modify the patients’ previous classification. When pre-hospital management has been efficient, an experienced emergency nurse can do the triage. If this is not the case, triage should be performed by an experienced physician or anesthesiologist from the emergency department.

The hospital command post, the advanced medical post, and the command post at the site of the disaster should be continuously in communication. The ambulances staff need to contact the hospital triage area 5 minutes before their arrival in order to prepare the sector.

Treatment areas
Establish clearly the treatment areas in the hospital, just as they were prepared following triage at the site of the incident. A trauma patient most likely will require at least 2 hours of surgical care. When the number of operating rooms is limited, it will be impossible to provide this care to many victims simultaneously. Therefore, prepare a specific area where the red code victims can be appropriately managed (red treatment area). An emergency specialist or an anesthesiologist should be in charge of this area, preferably located in the emergency department, and should be prepared to treat patients with extremely severe injuries.

Send the yellow code victims, immediately after triage, to a surgical ward vacated for receiving them. A hospital physician should be in charge. Watch over the victims continuously and re-evaluate them to keep them stable. If their condition worsens, transfer them to the red treatment area.

The victims with no hope for survival require only support care. These patients should be kept in a separate ward. Have an area ready for the deceased victims (black code).
SUMMARY

Planning is essential to reduce eventual risks and minimize dangers in the event of a disaster. It can be carried out in the family and the community settings and at the different levels of the health care system. Each community should develop its own local emergency plan. This local disaster plan needs to be adequately coordinated with the regional and national-level plans. Disaster plans should contemplate the basic needs of the affected individuals and the potential displacement of many people forced to abandon their homes, which may result in public health risks. The basic components of a disaster plan are: analysis of the situation, assumptions, goals, objectives, site organization, roles and responsibilities, coordination, and recording of critical information. The plan needs a realistic appraisal of available resources and extensive training.

In responding to a mass casualty incident, a special network of care should be instituted including the command post, the advanced medical post, evacuation and transport, and the coordinated system of hospital care. This system must be activated in a coordinated manner, and each component sector should be prepared to organize patient care in terms of common triage criteria (i.e., the classification of victims according to the urgency and priority of attention). During the mitigation phase, all lessons learned during the immediate response to the disaster are incorporated in the planning.
**SUGGESTED READING**


Romig LE. Pediatric triage: a system to JumpSTART your triage of young patients at MCIs. JEMS 2002;27(7):52-63.

Case resolution

Case 1

The hospital disaster plan is activated, while all victims are sent to a triage area set up in a safe location (e.g., hospital parking lot). A physician, accompanied by nurses from the emergency department, initiates triage. Patients with critical illnesses or trauma are transported directly to the emergency department. Those most severely affected are treated in the emergency department and receive immediate evaluation, while those with less severe injuries are given first aid in the parking lot or wait until they can be treated in the emergency department. The hospital disaster plan includes the possibility to convene physicians, nurses, social workers, and secretarial staff from any other hospital departments.

Case 2

The emergency care system verifies the incident, declares a massive disaster situation, and then it activates the disaster plan and sets into motion the ambulance service. A structure for the care of mass casualty victims is established, and children and adults are triaged. A command post is established. Local hospitals are contacted to inquire about their respective patient care capabilities. All the children with moderate to severe lesions are referred to the nearest pediatric trauma center, whereas adults with moderate to severe lesions are sent to an adult trauma center. After all the severely injured victims have been transported, those patients with minor lesions are referred to primary care facilities.
MODULE REVIEW

SECTION I: LOCAL EMERGENCY PLAN

1. What are the pediatrician’s specific functions in a disaster plan?
2. What factors should be considered when designing a local plan?
3. What areas should the plan cover?
4. What is the desired profile for the emergency plan coordinator, and what roles should he/she play?

SECTION II: PLANNING LEVELS

1. Planning should cover several levels. What are these levels, and what are the components and the adequate methods in each case?
2. What is PAHO’s SUMA system?
3. What individual and family factors related to a disaster situation should be taken into account?
4. What role do community organizations play in the sequential phases of a disaster situation?
5. How should these organizations be equipped to face the problems that affect children and are directly or indirectly related to the disaster?

SECTION III: MASS CASUALTY MANAGEMENT AND MEDICAL CARE

1. What are the basic components of a mass casualty management system?
2. How is a command post for an MCI established? What areas should be defined around the site of impact?
3. How is an advanced medical post organized?
4. What are the roles of the individuals involved in the emergency medical care chain? How are these roles determined?
5. At what points of the chain is triage performed, and what priorities are established in each case?
6. What special conditions should be considered when triaging a pediatric victim? How are these conditions integrated in an MCI where victims are not only children?
7. What data are essential for the internal communication within the system? How are these data transmitted?
8. What elements should be considered when organizing the transportation of victims to hospitals and other health care centers?
9. What systems of hospital care can be used in the response to an MCI? How do these systems operate?
10. What planning aspects correspond to the mitigation phase?
PAHO has created a number of function cards that define in detail the basic activities of the professionals involved in the coordination and the care of victims in an MCI.

1. Operator - dispatch center
   - Receives initial call or warning message concerning the event
   - Establishes: caller’s name and telephone number - nature of event - exact location of event - time of occurrence - approximate number of victims
   - Verifies information (if an unqualified observer)
   - Mobilizes and sends a dispatch team to site for initial assessment
   - Alerts potential responders (stand by)
   - Receives report of initial assessment
   - Dispatches necessary resources

2. Initial assessment team
   - Travels to site expeditiously
   - Identifies a leader
   - Establishes: precise location of the event - time of the event - type of incident
   - Estimates: number of casualties - added potential risk - exposed population
   - Team Leader reports initial information to dispatch center
   - Draws a single map of the area indicating: main topographical features - potential risk areas - victims - access roads - various field areas - limits of restricted areas - compass rose - wind direction
   - Directs resources arriving in the field until the arrival of a high-ranking officer
   - Hands over the map and briefs first arriving officer of rank
   - Reports to reassigned station

3. Fire services
   The Fire Services will be responsible for:
   - Safety
   - Search and rescue
   - Risk reduction
   - Definition of restricted areas
   - Providing a senior officer as a staff member of the Command Post
   - Providing the Advanced Medical Post (AMP) with a Transport Officer
4. Search and rescue team
- Locates victims
- Removes victims from unsafe locations to collection point if necessary
- Conducts initial triage of victims (acute/nonacute)
- Provides essential first aid
- Transfers victims to Advance Medical Post

5. Search and rescue officer
- Coordinates search and rescue activities by: identifying and assigning teams - supervising team functioning - establishing a collection point when necessary - coordinating the transfer of patients from the collection point to the Advance Medical Post communicating with Command Post for resource reinforcement - ensuring safety and welfare of search and rescue teams

6. Coordinator of the command post
- Performs overall coordination of the field operations
- Receives reports from the other officers in the Command Post
- Continuously assesses the general situation
- Coordinates requests between sectors in the field
- Ensures links between sectors
- Ensures the welfare of all staff involved in field operations
- Liaises with central headquarters, (e.g., EOCs)
- Authorizes releases to the media
- Acts as link between field operations and backup system
- Ensures adequate radio communication

7. Fire officer in command post
- Coordinates activities of the Fire Service in the field (ensures safety, search and rescue)
- Assists in transport organization
- Manages fire staff resource needs by: continuous assessment - requests for backup - timely rotation of staff - withdrawal of staff no longer needed
- Reports to the coordinator of the Command Post
8. Police officer in command post
- Ensures that radio communication is established and maintained
- Implements security measures to: maintain restricted areas - provide crowd and traffic control
- Manage field police resources by: continuous assessment of needs - redeployment of police officers - requests for backup - ensure adequate supply of necessary equipment
- This officer is generally the coordinator of the Command Post

10. Acute treatment manager (manager of advance medical post)
- Supervises triage and stabilization of victims in the AMP
- Establishes the internal organization of the AMP
- Manages the staff of the AMP
- Ensures that effective victim flow is maintained
- Ensures adequate equipment and supplies are available in each treatment area
- Organizes the transfer of patients to health care facilities in collaboration with the Transport Officer, the Health Officer in the Command Post and receiving Health Care facility
- Decides on the transfer order of victims, the mode of transport, escort, and destination
- Ensures staff welfare
- Reports to the Health Officer in the Command Post

9. Health officer in command post
- Supervises the field care of victims
- Provides the link between the health/medical backup system
- Ensures the adequate supply of manpower and equipment
- Receives reports from the manager of the Advance Medical Post (acute treatment manager)
- Deploys and manages health staff resources
- Reports to the coordinator of the Command Post

11. Medical triage officer
- Receives victims at the entrance of the AMP
- Examines and assesses the condition of each victim
- Categorizes and tags patients as follows
  - Red - immediate stabilization necessary
  - Yellow - close monitoring, care can be delayed
  - Green - minor delayed treatment or no treatment
  - Black - deaths
- Directs victim to appropriate treatment area
- Reports to the manager of the AMP
12. Red team leader
- Receives patient from medical triage
- Examines and assesses the medical condition of the victim
- Institutes measures to stabilize the victim
- Continuously monitors victim's condition
- Reassesses and transfers victims to other treatment areas
- Prioritizes victims for evacuation
- Requests evacuation in accordance with priority list
- Reports to the manager of the AMP

13. Evacuation officer
- Receives victims for evacuation
- Assesses the victim's stability
- Assesses the security of any equipment attached to victims and corrects deficiencies
- Ensures that immobilization is adequate
- Ensures that the tag is safely and clearly attached
- Maintains observation of victims until transported
- Supervises loading and ensure escort is briefed
- Reports to manager of the AMP

14. Transport officer
- Coordinates and supervises the transportation of victims
- Identifies access routes and communicates traffic flow to drivers
- Supervises all available ambulance drivers and drivers of assigned vehicles
- Receives requests for transportation
- Assigns appropriate vehicle tasks in accordance with specific needs
- Maintains a log of the whereabouts of all vehicles under his/her control
- Reports to the manager of the AMP

15. Administration clerk - triage area
- Maintains a register of all victims admitted to medical triage
- Records: victim’s name or identification number - age when possible - sex - time of arrival - injury category assigned
- Reports to Triage Officer
16. Administration clerk - evacuation area
- Maintains a register of all victims leaving the AMP
- Records: victim name/number - injury category - time of departure - mode of departure (vehicle) and escort - destination
- Reports to the Evacuation Officer

17. Ambulance driver
- Remains in the vehicle at all times
- Responds promptly to directives from Transport Officer
- Ensures that vehicle is parked in designated area and is ready to move
- Transports patients in accordance with safety rules and instructions
- Reports to Transport Officer
MODULE 4

Pediatric Trauma

Joseph Wathen | Kristen Crossman | Mario Acosta Bastidas
INTRODUCTION

The response to a disaster situation will vary dramatically depending on the type of disaster, the number of casualties, and the ability of the affected community to respond. A paramount issue is the level of preparedness achieved prior to such events. The possibility of having to assist injured children adds specific needs to the preparation process. Few physicians are prepared to handle a large number of injured patients, much less a large number of injured pediatric patients. Adequately skilled personnel is essential to assist severely injured children.

Initial strategies in managing a disaster situation include recognizing the area where the event took place and classifying and directing the affected individuals according to the severity of the injuries or damage (triage). Assisting a pediatric population presents additional challenges, because children may not be able to talk, they may be scared, or they may have been separated from their families. They may also suffer lesions that the rescue personnel are not be familiar with, such as crush and blast injuries or hypothermia. Providing treatment and transportation for these injured children should occur according to established priorities and available resources. Children with severe trauma often require immediate first aid before being transferred to an emergency center.
What elements should a plan for a disaster situation include?

First, assume that the health care facility, whatever its location, will need to function alone until outside help arrives. It is important to have a notification system to call in extra personnel.

It is always essential to use a triage (injured patient classification) system and to prepare adequate treatment areas to

CASE 1

Your health care unit is sent to a neighborhood to see a child who has suffered a fall. You find an 8-year-old boy lying on the grass near a big tree. An adolescent tells you that she saw him fall from the tree when he was at a height of about 30 feet. Nobody has moved him.

Initial assessment shows that the boy is responding only to painful stimuli. Breathing is superficial with audible snoring. The skin is pale, with mild cyanosis. Respiratory rate is 12 breaths per minute; heart rate is 130 beats per minute.

The skin is cold, radial pulse is weak, and capillary refill is >3 seconds. Pupils are equally dilated and are reactive to light. Air influx cannot be detected through auscultation in the right hemithorax and is diminished in the left. Oxygen saturation is 82%.

He has broken teeth and a swollen nose, with moderate hemorrhage. The abdomen is stiff on palpation. The right leg is swollen, with evident deformity to the femur.

- Based on initial assessment and type of trauma, what are the most probable injuries in this boy?

- Analyze the initial stabilization measures and pre-hospital management of this child.
handle the influx of patients. Free up operating rooms and intensive care beds and carefully check on all available supplies (blood, medications, communication equipment). Always consider decontamination procedures to be implemented as indicated. It is also necessary to ensure security in the emergency setting and to start transferring the injured people according to the priorities established through the classification process and the available resources. A public information center will be needed to handle media and family. Annual drills help familiarize the staff with the disaster plans, as well as provide feedback to fine-tune the plans.

**Available personnel**

Having a list of available personnel and appropriate means to contact them is a critical preparatory step in the face of a disaster. Arrange a central communication system that can activate a call-up roster to ensure the timely arrival of this help.

Once the personnel are at the medical facility, it becomes important to organize this labor force and provide job descriptions. A military model has been adapted to the hospital setting and is referred to as the Hospital Emergency Incident Command System (HEICS). HEICS has become the standard for health care disaster response and offers predictable management schemes, flexible organizational charts, prioritized response check-list, accountability of position function, and common language when communicating with outside groups.

**Specific pediatric equipment needs**

Specific equipment must be available in disaster emergency situations involving children. Box 1 displays a list of recommended equipment.

**Communication**

A very important aspect during a disaster situation is the ability to communicate, not only with others in the community but also among the medical personnel involved in responding to the situation. A coordinated response is needed in order to adequately handle a large influx of patients. Ideally, personal radios or cell phones should be available, so that the personnel involved in health care management communicate with each other and with the central command leader. The same applies to other areas (administration, security, maintenance).

**Scene safety and transport**

Most physicians are not trained in on-scene rescue efforts. In general, local police, firefighters, and hazmat teams are the best to initially approach and control a disaster scene. However, in confined spaces, triage may need to be set up in the
BOX 1. Recommended equipment for pediatric emergencies in disaster situations

Airway Management
- Oxygen source with flow meter
- 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
- Wall suctioning device or suctioning machine
- Suction catheters – Yankauer, 8, 10, 14F
- Oropharyngeal airway tubing (infant and adult sizes)
- Nasal tubing – infant, child, and adult sizes 1-3
- Optional for intubation
  - Laryngoscope handle with batteries
  - Milir blades – 0, 1, 2, 3
  - Endotracheal tubes, uncuffed – 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, cuffed – 7.0, 8.0
  - Intubation guides – small, large
  - Adhesive tape to secure endotracheal tube

Intravascular Access or Fluid Management
- IV catheters – 18-, 20-, 22-, 24-gauge
- Butterfly needles – 23-gauge
- Intraosseous needles – 15- or 18-gauge
- 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)

Miscellaneous
- Blood pressure cuffs – premature, infant, child, adult
- Nasogastric tubes – 8, 10, 14F
- Sphygmomanometer
- 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)

Monitoring Equipment
- Portable monitor/defibrillator (with settings <10)
- Pediatric defibrillation paddles
- Pediatric electrocardiogram (ECG) skin electrode contacts (peel and stick)
- Pulse oximeter 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.
What are the risks involved at the disaster scene?
Risks at the actual disaster scene vary according to the nature of the disaster. These include: structural instability and further collapse, fires, carbon monoxide, cyanide, dirty bombs, contamination with biologic material, and infectious agents. Other potential hazards in confined spaces include: poor air quality, airborne pollutants, toxic gases, an explosive/flammable atmosphere, and insufficient oxygen concentration (Box 2).

Ideally, patients will be promptly transported to a local medical clinic or hospital. The initial response at the scene of a large disaster, once the patient has been rescued, includes airway support, spine immobilization, and oxygen delivery. The increased neck flexion that occurs from the large head of small children on a backboard can be addressed with either a scooped-out head area on the backboard or with a small roll of cloth placed under the shoulders to elevate the trunk (Figure 1). Immobilization on a backboard is primarily expected to protect the
spine during transport and facilitate transport. It is important to get the child off the backboard within a couple of hours.

Keeping the airway open during transport of the traumatized child is a top priority. Airway support can be adequately maintained with bag-valve-mask ventilation (BVM). Intubation in children prior to transport is not necessary and has not been shown to improve outcome. In fact, endotracheal intubation can lead to delayed transport and increased morbidity due to improper tube placement or possible dislodgement of the tube during transport. A large study in children compared endotracheal intubation versus BVM in the pre-hospital setting. This study included 830 patients below age 13, randomly assigned to BVM or endotracheal intubation. Results showed there was no advantage in placing an endotracheal tube (ETT) prior to transport to a hospital (Gausche et al., 2000). This adds to the risks that may arise from improper ETT placement.

Injured individuals with high morbidity or mortality risk should be promptly transported. The highest level of pediatric health care is needed for falls, fires, explosions, blunt injuries, and penetrating injuries (Box 3).

Injurious injuries: shot, stabbing

**FIGURE 2. Bag-valve-mask ventilation**

- Midline position
- “Open” airway
- Proper-sized mask
  - Good seal
  - Fingers on bony landmarks
- Proper-sized bag

**BOX 3. High-risk pediatric injuries**

- Falls from more than 6 m
- Fires: burns and asphyxia or high-risk burns (>10% second-degree or >5% third-degree or any burn with airway involvement)
- Explosions
- Blunt trauma: Significant injury with physiologic compromise: tachycardia with at least two signs of hypoperfusion or hypotension for age or altered mental status or spinal cord injury with neurological compromise
- Penetrating injuries: shot, stabbing

**FIGURE 2. Bag-valve-mask ventilation**

- Midline position
- “Open” airway
- Proper-sized mask
  - Good seal
  - Fingers on bony landmarks
- Proper-sized bag
Global management of the child with trauma

The management of pediatric trauma requires a systematic approach. ABCDE is a widely accepted strategy for initial evaluation, stabilization, and immediate treatment if necessary, and it must then be followed by secondary evaluation. This process usually takes place before detailed personal history or complete physical examination data are available.

Three peaks of trauma mortality rates can be identified. The first peak corresponds to deaths within the first seconds or minutes after the traumatic event, due to serious injury to the brain, spinal cord, heart, or aortic or large vessels. Few patients are able to survive these injuries, even with immediate assistance.

The second peak in mortality rates occurs from minutes to hours after the trauma. These patients have better survival chances if they are treated during the first key hours after the incident (golden hours) or, ideally, during the first hour. The injuries associated with this peak include epidural or subdural hematoma, hemothorax or tension pneumothorax, lesions with significant bleeding, such as intra-abdominal injuries (spleen laceration or rupture), and complex pelvic fractures.

OBJECTIVES

• Recognize the distinctive features of global management of the child with trauma.
• Assess children with trauma according to specific priorities.
• Name the most common traumatic injuries among children.

CASE 2

You are called to a sports field where a 6-year-old girl has been knocked with a hockey stick. The girl has a large hematoma in the forehead and is crying. She has not lost consciousness, but she is not making eye contact with her teacher or with you. She looks altered, her blood pressure is normal, and the ABCDE assessment shows normal vital signs with no other apparent injuries. During the initial evaluation the girl exhibits progressive drowsiness and it is difficult to wake her.

• What is the major threat to this patient’s life?
• What interventions are needed?
The third peak in trauma mortality rate occurs from days to weeks after the traumatic event and is due to multisystemic failure or sepsis.

The Advanced Trauma Life Support (ATLS) course was designed in the United States to provide health personnel with a tool for a systematic approach to the management of injured patients. In this course, emphasis is placed on management during the first critical hour. The same guidelines are used in a disaster situation that requires management of large numbers of victims. The goal with each patient is to identify and manage the most life-threatening condition using the ABCDE approach. This approach can be used with both adults and children, as long as pediatric-specific features are taken into consideration.

What are the features specific to pediatric patients?
There are specific differences between children and adults to be considered in emergency settings. Children are at a disproportionately increased risk for different reasons:

- High respiratory rate: Children are more vulnerable to aerosolized agents, chemicals, carbon monoxide, etc.
- Less fluid reserve: Children are more susceptible to dehydration.
- Less circulating volume: Smaller amounts of blood loss can lead to hypovolemic shock.
- Developmental vulnerabilities: Infants and toddlers are less able to escape a disaster; they cannot follow directions or make immediate choices.
- Anatomic and physiologic differences:
  - Prominent occiput: Flexion of the neck on spine boards.
  - Increased amount of secretions: May require more suctioning.
  - Infants ≤3 months are obligate nose breathers: Susceptible to anatomic obstruction and infections.
  - Relatively larger tongue compared with mandible: May make use of bag-valve-mask or intubation difficult.
  - Large adenoids: Bleeding is common, especially with nasal intubations.
  - Flexible, omega-shaped epiglottis, with anterior location: Intubation and visualization of the larynx require lifting the epiglottis with a straight blade.
  - Smaller diameter of the subglottic region until about age 8; therefore noncuffed endotracheal tubes (ETTs) are used until ~8 years of age to avoid cuff trauma.

How is a child with trauma assessed?
Assessment of pediatric trauma includes an ABCDE approach adapted to pediatric characteristics. This approach encompasses the identification and treatment of pediatric trauma, such as traumatic brain
injury, respiratory and thoracic trauma, and blunt abdominal trauma (Box 4).

**Primary survey**
The primary survey is the initial evaluation of the patient, where life-threatening problems are identified and treated. It is designed to assess each of the following items in a given order (Nichols et al, 1996):
A Airway maintenance
B Breathing and ventilation
C Circulation with hemorrhage control
D Disability: neurologic status
E Exposure/environment

Box 4. Assessment of the child with trauma

- Primary survey
- Secondary survey
- Pediatric trauma score (PTS)

**Airway**
The goals of airway management are recognition and relief of obstruction, prevention of gastric content aspiration, and promotion of adequate gas exchange. In managing a trauma patient’s airway it is important to take potential cervical spine injuries into consideration. Maintain midline positioning and perform a jaw thrust maneuver to open the airway and protect the cervical spine. In these cases, tilting the head or lifting the chin is contraindicated. Cervical spine immobilization should include a hard cervical collar.

Airway assessment determines whether the airway is stable. If necessary, perform airway maneuvers such as jaw thrust maneuvers and nasal or oral suctioning to keep the airway open. Despite these maneuvers, it may be impossible to maintain the airway. In this case, placing an ETT with rapid sequence intubation to secure the airway would be the first option, followed by a cricothyrotomy as last resort (Box 5).

Box 5. Airway assessment in children

- Stable airway
- It IS possible to keep the airway open
  - Airway opening maneuvers
  - Devices: oral or nasal airway
- It is NOT possible to keep the airway open
  - Bag-Valve-Mask (BVM)
  - Endotracheal tube (rapid sequence intubation)
  - Cricothyrotomy
racic movements, air influx, proportion of oxygen in inspired air, skin color). Some patients, such as those with pulmonary contusions, will need positive pressure ventilation. This can initially be provided using BVM ventilation until a definitive airway is obtained. New standards for assessing ventilation include the use of CO₂ monitors. Finally, inspect the chest wall looking for signs of pneumothorax or evidence of other chest wall trauma.

Circulation
After airway and breathing assessment and stabilization have been completed, the next step is the assessment of circulation. Adequate circulation can be determined by assessing the pulse strength and rate both centrally and peripherally. Capillary refill, although potentially affected by environmental factors such as temperature, can also help to determine peripheral perfusion. Measure blood pressure, keeping in mind that in children compromised circulation may occur despite a normal blood pressure. Hypotension in children will not be evident until 25% to 30% of blood volume is lost.

Tachycardia is an early marker of hypovolemia in children. It represents a compensatory mechanism to blood loss and is more marked in children than in adults. Once hypotension occurs, the child is in very serious condition.

If necessary, control external hemorrhage by putting direct pressure on the wound. This includes assessing the back of the patient; head scalp injuries, for example, can be associated with significant bleeding. In general, use thin compression dressings rather than bulky dressings, so that adequate pressure to the bleeding site can be delivered. Intravenous fluid resuscitation can begin immediately. Obtaining an intravenous access is sometimes the most life-saving approach.

State of consciousness
State of consciousness is evaluated through a quick neurologic assessment. Assess whether the child is alert, responsive to verbal or painful stimuli, or unresponsive (AVPN). In addition, assess the pupils for size, equality, and response to light. A quick motor exam can determine if all four extremities show motor activity. A detailed neurologic exam can wait until the secondary survey. Some medical facilities will assign the child a score at this point using the adult/child and infant versions of the Glasgow Coma Scale (GCS) (Tables 3 and 4, Box 6). A score of 8 or lower indicates a significant neurologic disability, which means that the airway will need to be secured with an ETT.

Exposure/environment
Assessment of issues related to exposure/environment entails the entire body, so remove clothing for a complete evaluation. Among the concerns related to environment is proper body temperature regulation. It is important to bear in mind that infants can rapidly become hypothermic, due to
to their large surface area-to-volume ratio. This is particularly true if the child is wet.

**Secondary survey**
The secondary survey starts after the ABCDE assessment has been completed and initial management of life-threatening conditions has taken place.

Vital signs are assessed and appropriate monitors are placed as needed. The secondary survey consists of a detailed head-to-toe examination. Also included are a history of the trauma event, as well as a brief history (allergies, medications, past illnesses, last meal). Monitor the patient continuously during this survey and obtain

### TABLE 3. Glasgow Coma Scale (adult/child)

<table>
<thead>
<tr>
<th>Eyes Open</th>
<th>Verbal Response</th>
<th>Motor Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Spontaneous</td>
<td>5. Oriented and speaks</td>
<td>6. Obeys verbal commands</td>
</tr>
<tr>
<td>3. To speech</td>
<td>4. Disoriented and speaks</td>
<td>5. Localizes pain</td>
</tr>
<tr>
<td>2. To pain</td>
<td>3. Inappropriate words</td>
<td>4. Withdraws in response to pain</td>
</tr>
<tr>
<td>1. Absent</td>
<td>2. Incomprehensible sounds</td>
<td>3. Decorticates to pain</td>
</tr>
<tr>
<td></td>
<td>1. None</td>
<td>2. Decerabrates to pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. No response</td>
</tr>
</tbody>
</table>

### TABLE 4. Glasgow Coma Scale (infants)

<table>
<thead>
<tr>
<th>Eyes Open</th>
<th>Verbal Response</th>
<th>Motor Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. To speech</td>
<td>4. Irritable cries</td>
<td>5. Withdraws to touch</td>
</tr>
<tr>
<td>2. To pain</td>
<td>3. Cries to pain</td>
<td>4. Withdraws in response to pain</td>
</tr>
<tr>
<td>1. Absent</td>
<td>2. Moans to pain</td>
<td>3. Flexion</td>
</tr>
<tr>
<td></td>
<td>1. No response</td>
<td>2. Extension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. No response</td>
</tr>
</tbody>
</table>
SECTION II / ASSESSMENT

Laboratory and radiologic studies. Definitive care can begin by splinting fractures and applying wound dressings. Finally, a staff member should provide emotional support to the child until family members are present.

**Pediatric trauma score**
The pediatric trauma score (PTS) is used to rapidly assess the severity of the injury. This can be used to triage children and determine referral to pediatric trauma centers. It consists of six parameters that are evaluated during the initial assessment. Children with a score of 8 or less should be treated in a designated trauma center (Tables 5 and 6).

### What are the most common traumatic injuries in children?

#### Head injuries
Pediatric head injuries are among the most common pediatric traumatic lesions. In general, children have a thinner and more flexible skull that transfers force of trauma to the brain more intensely than in adults. Anatomically, younger children have a disproportionately larger head and weaker neck muscles than adults. When these children are involved in a trauma event, they tend to “lead with their heads.” When a child presents with a significant brain

<table>
<thead>
<tr>
<th>Category</th>
<th>+2</th>
<th>+1</th>
<th>-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size/weight</td>
<td>&gt;20 kg</td>
<td>10-20 kg</td>
<td>&lt;10 kg</td>
</tr>
<tr>
<td>Airway</td>
<td>Normal</td>
<td>Stable</td>
<td>Unstable</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>&gt;90 mm Hg</td>
<td>50-90 mm Hg</td>
<td>&lt;50 mm Hg</td>
</tr>
<tr>
<td>Mental status</td>
<td>Awake</td>
<td>Confused</td>
<td>Comatose</td>
</tr>
<tr>
<td>Open wound</td>
<td>None</td>
<td>Minor</td>
<td>Major</td>
</tr>
<tr>
<td>Fractures</td>
<td>None</td>
<td>Closed</td>
<td>Open or Multiple</td>
</tr>
</tbody>
</table>

**TABLE 5. Pediatric trauma score (PTS)**

<table>
<thead>
<tr>
<th>Category</th>
<th>+2</th>
<th>+1</th>
<th>-1</th>
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</tr>
<tr>
<td>Fractures</td>
<td>None</td>
<td>Closed</td>
<td>Open or Multiple</td>
</tr>
</tbody>
</table>

**BOX 6. Glasgow Coma Scale (GCS) Values**

- A score between 13 and 15 may indicate a mild head injury
- A score between 9 and 12 may indicate a moderate head injury
- A score \( \leq 8 \) indicates a severe head injury (endotracheal intubation is usually required)
When a child presents with a significant brain injury, also known as a traumatic brain injury, consider oxygen delivery to the brain and cerebral perfusion pressure.

**TABLE 6. Pediatric trauma score (PTS)**

<table>
<thead>
<tr>
<th>Score</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;8</td>
<td>&lt;1% predicted</td>
</tr>
<tr>
<td>&lt;8</td>
<td>Suggests referral to trauma center</td>
</tr>
<tr>
<td>4</td>
<td>Predicts 50% mortality</td>
</tr>
<tr>
<td>&lt;1</td>
<td>Predicts &gt;98% mortality</td>
</tr>
</tbody>
</table>


When a child presents with a significant brain injury, also known as a traumatic brain injury (TBI), consider oxygen delivery to the brain and cerebral perfusion pressure (CPP).

CPP is the difference between the mean arterial pressure and the intracranial pressure. It is important to maintain a good mean arterial pressure and to perform measures that decrease the intracranial pressure. Some measures, however, can be performed only in the intensive care setting.

When the intracranial pressure rises significantly, vital signs can be altered. Cushing’s triad consists of hypertension, bradycardia, and irregular breathing pattern. In children, bradycardia is typically the first manifestation and may serve as a sign of impending brain herniation.

TBI can be classified as either primary or secondary. Primary brain injuries are those produced during trauma and may include brain contusion, diffuse axonal injury, or intracranial hemorrhage (Figure 7).

Secondary brain injuries include those that appear later as a result of metabolic effects, such as cerebral ischemia and cerebral edema. These injuries are usually seen hours to days after the traumatic event and can be minimized with proper medical care.

The management of a child that presents with a TBI begins with the ABC (airway, breathing, circulation) approach. The airway needs to be maintained with cervical spine precautions. All children should receive 100% oxygen, and intubation should be considered for GCS score ≤8, or for patients in whom it is not possible to maintain a stable airway. Ventilation should be assisted to maintain a PCO₂ of 35 to 40 mm Hg. If there are clinical signs

**FIGURE 7. Types of intracranial hemorrhage**

- Epidural
- Subdural
- Subarachnoid
- Intracerebral

Subdural hemorrhage with midline shift.
of brain herniation or neurologic deterioration, a lower PCO₂ may be warranted.

Circulation issues include maintaining the mean arterial pressure and avoiding hypotension. Intravenous access needs to be established and either normal saline, lactated Ringer’s solution, or packed red blood cells can be given. If hypotension is still present after volume expansion, cardiovascular pressor medication may be needed. Once the child is euvoletic, intravenous fluids can be administered at a maintenance rate.

Trauma laboratory studies and radiographs can be obtained as needed and may include serum electrolytes, glucose, complete blood count (CBC), partial thromboplastin time (PTT), prothrombin time (PT), and international normalized ratio (INR). (Significant TBI can cause coagulation alterations.) Maintain the head in a neutral position with a rigid cervical collar in place.

Needed medications may include agents that provide short-term sedation and analgesia, such as midazolam (0.1 mg/kg) and fentanyl (1-2 mcg/kg). If there are clinical signs of intracranial hypertension, such as an unequal pupil dilation, abnormal posturing, or Cushing’s triad, additional therapeutic measures include deep sedation, mannitol (0.5-1 g/kg), and hyperventilation (at PCO₂ of 25-30 mm Hg) until clinical signs improve. Hyperventilation should be limited to serious injuries with no adequate response to other interventions. Finally, consider placement of a Foley catheter and a nasogastric or oral-gastric tube in patients with severe post-traumatic brain injuries.

**Thoracic injuries**

In children, thoracic injuries are associated with a high mortality rate. The greater elasticity of the ribs and sternum makes fractures less common than in adults, but there is a higher rate of energy transfer to the underlying structures (Box 7).

**Pulmonary contusions** are the most frequent type of injury occurring with thoracic trauma. They are often missed because the initial clinical findings can be subtle. A pulmonary contusion is essentially a bruise of the lung that leads to alveolar hemorrhage and interstitial hemorrhage and edema. The severity is related to the extent of lung tissue involved. Clinical signs and symptoms include soft tissue marks on the chest, tachypnea, use of accessory respiratory muscles, and hypoxia. Continuous pulse oxymetry is needed, as well as laboratory determinations of blood gas, assessing the degree of PaO₂ reduction and PaCO₂ increase. Treatment of lung contusions consists of oxygen therapy, close monitoring, and intubation, with positive end-expiratory pressure (PEEP) if needed.

In all pneumothoraces, air enters the pleural space. This results in loss of negative pressure and collapse of the lung. Air
When hemothorax occurs draining the blood from the chest with a chest tube (posterior location) and treating the hypovolemia are the keys to therapy.

Pneumothorax may enter either through a hole in the chest wall or a hole in the lung, bronchus, or trachea. An open pneumothorax exists when there is an opening in the chest wall. Immediate treatment of such a condition consists of applying an occlusive dressing. Pneumothorax can either be simple or under tension. Assessment of the trachea helps differentiate between the two. Tension pneumothorax is a clinical diagnosis made by tracheal deviation away from the side of the pneumothorax, absent breath sounds, hypotension, and possibly distended neck veins. In children, it may be difficult to clinically determine jugular venous distension and tracheal deviation. Tension pneumothorax is a clinical diagnosis requiring immediate needle decompression at the second intercostal space, mid-clavicular line or placement of a chest tube in the fourth to fifth intercostal space, mid-axillary line (Figure 8).

Hemothorax occurs when blood accumulates in the pleural space, which can then compress the lung. A massive hemothorax indicates a large lung injury with potential involvement of large vessels (Figure 9).

Draining the blood from the chest with a chest tube (posterior location) and treating the hypovolemia are the keys to therapy.

**BOX 7. Frequency of thoracic injuries in pediatric trauma**

- Pulmonary contusion/laceration (53%)
- Pneumothorax/hemothorax (38%)
- Rib/sternum fractures (36%)
- Other lesions
  - Cardiac (5%)
  - Diaphragm (2%)
- Major blood vessels (1%)

**FIGURE 8. Pneumothorax**

- Simple vs Tension
  - Trachea
  - Distended neck veins
- Air enters chest
  - Loss of negative pressure
  - Collapse of lung
  - Hole in chest wall vs hole in lung/bronchus/tracheal deviation
- Open
  - Occlusive dressing
- It can be difficult to clinically determine jugular venous distension and tracheal deviation. It can also be difficult to determine which hemithorax is experiencing a reduction in air influx.
**Pericardial tamponade** presents when fluid accumulates in the pericardial sac. In trauma, this fluid is blood and usually presents over minutes to hours. This fluid causes a restriction on the myocardium leading to decreased cardiac output and hampered venous return. Clinically, Beck’s triad suggests pericardial tamponade: reduced pulse pressure, neck vein distension, and muffled heart tones. Arrhythmias can be present including bradycardia, pulseless electrical activity (PEA), and asystole. The treatment includes pericardiocentesis and intravenous fluids. Clinical suspicion should arise when a penetrating trauma to the trunk has occurred. Look for soft tissue marks, such as entry site of a penetrating object and bruises across the chest wall.

**Abdominal trauma**

Abdominal injuries are the third leading cause of traumatic death in children, after head and thoracic injuries.

Abdominal injuries can affect solid or hollow organs. The most common injury is that of the spleen. In general, the abdomen represents a site of “silent” hypovolemia. Other sites of silent hemorrhage that can be responsible for hypovolemia are the pelvis and the retroperitoneum.

Paramount to treatment is fluid and/or packed red blood cell replacement with constant reassessments of the patient’s hemodynamic status. For most patients this treatment will be sufficient; surgical hemostasis is rarely needed. The unique features of the abdomen in children include a thin abdominal wall, a decreased AP-diameter, increased lordosis, proportionately larger spleen and liver, exposed below the rib cage, and a kidney that is more anterior with less perinephric fat.

**Extremity trauma**

Extremity trauma is very common. Fractures of the radius, ulna, and femur are most common and may be either open or closed. Always assess the neurovascular status. Initial management of extremity trauma includes recognition, splinting, neurovascular assessment, and pain control.
If there is an open wound, first clean it and then cover it. Different types of splinting devices can be used. At the scene of the disaster, use whatever is available (wood, magazines, the other leg). Once at the medical facility, fiberglass splints are ideal as they are stronger and more water-resistant than plaster (Box 8).

Femur fractures will also benefit from traction because of the larger muscle groups involved. Treat patients for pain and sedate them with narcotics, sedatives, and muscle relaxants.

**Open fractures** add the concern of infection to the medical management. Open fractures also imply that a significant force has been involved. It is therefore important to look for other injuries. In addition to infection, other complications of open fractures include nerve entrapment and compression. Treatment of an open fracture includes cleaning, covering without suturing the opening, intravenous antibiotics, and immobilization. Ideally, these injuries will need surgical debridement (Figure 10).

**Pelvic fractures** are a concern because they are generally the result of high-impact blunt trauma; blood loss can be significant. The pelvic ring may be fractured in a single place, which would be a stable fracture, or more commonly in multiple places, which could be an unstable fracture. Additional injuries associated with pelvic fractures include genitourinary and abdominal lesions, and vascular abnormalities (i.e., pelvic vein disruption). A sheet tightly wrapped around the pelvis may be the only temporizing measure for the unstable, bleeding pelvic fracture (Figure 11) until operative treatment is arranged.

---

**BOX 8. Keys to proper splinting**

- Cleaning and bandaging skin wounds prior to splinting
- Padding in layers prior to adding the splint, with extra padding at pressure points
- Making sure to splint the joint above and below the fracture

---

**FIGURE 10. Open fractures**

- Imply significant force: look for other injuries
- More complications: infection, nerve impingement
- Treatment: clean, cover, do not suture, IV antibiotics, keep NPO, and immobilize
- Will need OP surgical debridement
Fractures that need orthopedic referral include those that affect joints or growth plates, fractures around the elbow or knee with significant soft tissue swelling (compartment concern), and fractures associated with an open wound or with signs of vascular or nerve disruption.

**FIGURE 11. Pelvic fracture**
DISASTER-SPECIFIC TRAUMATIC INJURIES

OBJECTIVES

- Establish specific care procedures for victims of fires and burns in general.
- Emphasize the characteristics of injuries caused by bombs or blasts and their initial treatment.
- Characterize the crush syndrome, its consequences, and treatment.

Burn injuries
Because of their unique pathophysiology, burn injuries increase the morbidity and mortality in any patient with trauma. Early intervention and resuscitation have a direct impact on survival and degree of long-term disability. A recent study involving children with burns involving more than 80% total body surface area revealed that the major determinants of mortality include: total body surface area burned, age, inhalation injury, time to resuscitation, and the amount of initial resuscitation fluids administered (Wolf et al., 1997).

Pathophysiology
Burns cause both local lesions and systemic alterations, depending on the type and degree of the burn. The local response involves not only direct tissue coagulation, but also microvascular reactions in the surrounding dermis, resulting in extension of the injury (Aggerwal et al., 1994). Systemic response involves the release of vasoactive mediators. Thus, with burns involving more than 20% total body surface area, interstitial edema develops throughout the body due to chemical mediators and hypoproteinemia. Airway security is the first priority during the initial evaluation. Inhalation injuries are

INITIAL THERAPY OF MODERATE-TO-SEVERE BURNS

- Remove all clothing.
- Assess burn size and severity.
- Cool down burnt areas with sterile water.
- Keep the patient warm to avoid hypothermia.
- Early rapid sequence intubation in case of inhalational injury.
- Volume expansion based on Parkland formula. (See Appendix for additional options)
- Assess the need for escharotomy.
- Watch for signs of rhabdomyolysis.
- Cover all burnt areas with dry, sterile dressings.
- Transfer to a burn center.
SECTION III / TRAUMATIC INJURIES

primarily a clinical diagnosis, as many burn patients present with initially normal chest radiographs and little to no pulmonary dysfunction. Physical findings suggestive of inhalation injury include decreased mental status; evidence of respiratory distress or upper airway obstruction; carbonaceous material around the mouth or nose; singed nasal hairs, eyebrows, or eyelashes; and burns to the face and neck.

The pathophysiologic consequences of inhalation injuries include upper airway edema from direct thermal injury exacerbated by systemic capillary leak, bronchospasm from aerosolized irritants, small airway occlusion with sloughed endobronchial debris, and loss of the ciliary clearance mechanism. In addition, there can be increased dead space and intrapulmonary shunting from alveolar flooding, and decreased lung and chest wall compliance from interstitial and alveolar edema. Infection of the denuded tracheobronchial tree (tracheobronchitis) or pulmonary parenchyma (pneumonia) can occur (Sheridan, 2002).

In patients who exhibit clinical findings of inhalational injury, perform endotracheal intubation right away, because increasing edema will make later intubation difficult, if not impossible. When intubating burn patients, endotracheal tube size should be smaller than expected for the patient’s size, and cricothyrotomy tools should be readily available for emergency intervention. Upper airway edema usually resolves in 2 or 3 days.

This can be facilitated by elevating the head of the bed and avoiding extra fluid resuscitation for volume expansion.

Other considerations regarding smoke inhalation include exposure to carbon monoxide and more rarely hydrogen cyanide, which both block the body’s ability to utilize oxygen. In the field, ventilation support of the burn patient should always include initial treatment with 100% oxygen with a non-rebreather mask. If there is suspicion of carbon monoxide exposure (altered mental status, loss of consciousness, headache, vomiting, etc.), as there often is with burns that occur in enclosed spaces, administer 100% oxygen to decrease the half-life of carboxyhemoglobin from 4.5 hours to 50 minutes. In this situation, pulse oximetry is inaccurate and oxygen saturation of the blood can only be determined by arterial blood gases. Cyanide antidote kits may be needed for cyanide poisoning.

Another issue related to pulmonary function is bronchospasm from inhaled particles and gases. This problem often responds to inhaled or intravenous bronchodilators, low dose epinephrine infusions, or parenteral steroids (Carlotto et al., 2005). High-frequency ventilators are yet another option for burn patients with extreme oxygenation failure (Schwartz et al., 1989).

Significant burns to the trunk may limit the ventilatory capacity of patients and may require escharotomies to allow the chest to expand (Thomas et al., 2003).
Circulation
Due to severe capillary leak into the interstitial space in the hours following severe burns, prompt fluid resuscitation is imperative to re-expand intravascular volume, especially in patients with burns involving 15% to 20% of total body surface area. A number of studies have found that the most significant contributing factor to mortality among patients with massive burns is delay in the initiation of fluid resuscitation (Wolf et al., 1997; Kagan and Warden, 2001). Most formulas agree that half of the calculated volume should be delivered within the first 8 hours and the second half over the remaining 16 hours in a 24-hour period. Generally, the fluids within the first 24 hours should be isotonic crystalloid or lactated Ringer’s solution. Colloid and blood solutions generally are not administered during the first 24 hours after a burn, but, in the case of severe burns, cautious treatment with albumin can be beneficial. The recommended resuscitation schedule is administering the least amount of fluids required for appropriate tissue perfusion and urine output of at least 1 ml/kg/hour. Two of the formulas for estimating fluid requirements are Parkland and Carvajal or Galveston. Parkland formula is used most often and is useful as a guide only to initiate fluid volume replacement. Subsequent replacement depends on the state of the patient and is based on the reposition of 2

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**BOX 9. Calculations of fluid needs for volume expansion**

**PARKLAND FORMULA**

**First 24 hours**
- Adults and children >20 kg
  - Lactated Ringer: 2-4 mL/kg/%burn/24 hours
    (half in first 8 hours and the other half in following 16 hours)
  - Colloid: none

**NOTES:**
If the patient develops hypotension, give 20 mL/kg crystalloid until normotension is achieved.

**Second 24 hours, based on urine output:**
- <1 mL/kg/hour: 20 mL/kg crystalloid solution
- 1-3 mL/kg/hour: continue with Parkland formula
- >3 mL/kg/hour: reduce to 2/3 of initial formula

**Goal urine output varies depending upon the age of the patient:**
- Adults: 0.5 mL/kg/hour
- Children: 1 mL/kg/hour
- Infants: 1-2 mL/kg/hour
to 4 ml of solution by estimated percentage of body burned multiplied by the child’s body weight in kg. Parkland formula does not include maintenance therapy (Box 9). Carvajal or Galveston formula, in contrast to Parkland formula, is based on body surface area instead of body weight. Therefore, in order to estimate body surface, not only the weight but also the height of the child is taken into account. This formula can be used to estimate fluid requirements when dealing with children (see Appendix).
Estimation of burn extent

There are several charts to use. One is the rule of nines originally based on the estimation of adult body proportions, but adapted to children, as shown in Figure 13.

The Lund-Browder chart is an age-specific chart that is used for children of up to 10 years, because it accounts for changing body proportions with age, such as the disproportioned size of the neck and head relative to lower extremities (Tables 7 and 8, Figure 12).

The palmar surface of the hand (without fingers) can be used for second-degree burns or greater, with a palm-size area equaling 0.5% to 1.0% body surface area (Kagan and Warden, 2001; Sheridan et al., 1995).

Burns can be classified according to depth. First-degree are red, dry, and painful; second-degree are red, wet, and very painful; third-degree are leathery, dry, insensitive, and waxy, and fourth-degree involve underlying tissues, tendons, and bones.

Oral rehydration

Although recommended fluid resuscitation for patients with total body surface area burns greater than 15% to 20% is by parenteral (IV) route, certain trauma or combat situations have limited resources. In light of the need for prompt initiation
of fluids to decrease morbidity and mortality, several authors have suggested using oral rehydration solutions similar to lactate Ringer with the addition of glucose, or the World Health Organization’s oral rehydration solution (with an osmolality range of 260-330 mOsm/L) given orally or through nasogastric tube. (Thomas et al., 2003). The drawback of oral rehydration of burn patients relates to the initially increased absorption time in comparison to intravenous fluids and the concern for poor gut function secondary to splanchnic underperfusion.

**What is the initial wound care for burn injuries?**

Treatment starts with stopping the burning process. Roll the child in a blanket or rug, taking care not to cover the face to avoid inhalation of fumes.

Rinse chemical burns with copious amounts of clean water.

Remove clothing and jewelry. Cool or wet dressings have no role in management of burn injuries; cover burns with a clean, dry bandage. Subsequent treatment involves cleansing and debriding loose epidermis and blisters. Topical agents that can be used include vaseline-impregnated gauze, mafenide acetate cream, triple antibiotic ointment, and silver nitrate solution. More superficial wounds (involving the epidermis) and facial wounds can be dressed initially with a clean, dry dressing or with bacitracin or vaseline. Cleanse and dress deeper burns with silver sulfadiazine. Wounds treated with aqueous topical agents, especially those containing silver, are associated with secondary hyponatremia, requiring isotonic crystalloid and additional salt in enteral solutions. Careful serum sodium monitoring is imperative, because cerebral edema and seizures can occur with severe hyponatremia (Sheridan, 2002). Tetanus prophylaxis is indispensable.

Another consideration in the care of burn injuries is monitoring for signs of tissue compromise. Certain types of burns (e.g. circumferential burns of limbs, trunk, or abdomen, as well as electrical burns) are especially at risk of tissue compromise. Pain and color are unreliable markers of perfusion; generally, a warm extremity is a well-perfused extremity. Remove all constricting clothing, elevate the burned area if possible, and carefully monitor pulses. Do not wait for the development of a compartment syndrome to perform an escharotomy. Because the eschar is insensitive, escharotomies can be performed in most patients at the bedside using sedation and analgesics. Patients with large burns and generalized massive tissue edema may require intraoperative fasciotomies.

**Special situations**

**Electrical injury**

Low- and intermediate-voltage exposures can cause locally destructive injuries, as
well as systemic complications. High-voltage exposures cause delayed neurologic and ocular sequelae. It is necessary to serially examine injured extremities for intracompartmental edema requiring decompression. Place bladder catheters to document and treat myoglobinuria.

Chemical injury
Irrigate the wounds with abundant clean water (isotonic crystalloid for eye globe injuries). Close monitoring of electrolytes is necessary.

Tar injury
Water irrigation is initially needed to cool molten tar and stop the burning process. Then, remove the cooled tar with lipophilic solvent during the debriding process.

Overall, prompt management of burn patients—with careful monitoring of airway, fluids and electrolytes, and clinical status—will directly impact on morbidity and mortality. Definitive management will be determined by the degree of injury, concomitant injuries, and availability of resources.

In a disaster situation with many burned victims and poor resources, priority should be given to admitting children with a burned surface area of more than 10%, those having the face, the hands, the feet and the perineum burned, those having joints burned and circumferential injuries, and those that can’t be treated out of hospital for these or other injuries. It is wise to try to establish at least one IV access in patients with burns of more than 10% body surface areas and start fluid replacement with crystalloid 20 ml/kg.

Burns affecting the airway need on site urgent interventions, such as protection of the airway and fluid administration.

Pain should be managed with painkillers and sedatives, titrating doses to the desired effect. The patient should be transferred as soon as possible. When transportation is delayed or prolonged, consult the Burn Department of the reference hospital to establish the rate of intravenous fluid replacement.

Blast injuries
Bombs and explosives can cause distinctive injuries. Survivors of an explosion typically suffer both penetrating and blunt trauma injuries. Blast lung is the most common lethal injury. Half of all initial casualties will seek medical care over a one-hour period.

The upside-down triage triangle (▼) is a reminder that the least sick will arrive at the hospital first, whereas those who are sicker, trapped, closer to the explosion site, or unable to ambulate will arrive later after rescue and in smaller numbers.

Explosives can be classified as either high-order (HE) or low-order (LE). High-order explosives, such as TNT, C-4, nitroglycerin, or ammonium cause a supersonic over-pressurization shock wave. Low-order explosives, such as black
powder or nitrocellulose cause a subsonic explosion.

Most of the injuries seen after HE detonations are blunt, penetrating, and thermal trauma. Soft-tissue and head injuries are the most common injuries. Orthopedic injuries are also common. Primary blast injury is a less common, often subtle or delayed potentially life-threatening problem that must be considered. It is a result of abrupt pressure changes generated by the blast wave. As the Friedlander curve shows, a blast wave generates a shock wave that expands spherically. There is an instantaneous rise to a peak over-pressure that declines exponentially to an under-pressure (zone behind the high-pressure blast) (Figure 14). The rapid pressure change is the cause of the primary blast injury. Both high- and low-pressure changes can cause injury.

**What types of injuries are associated with blast trauma?**

**Primary injury**
Primary injury is the result of the excessive pressure generated by the blast wave. It affects all air- or fluid-filled cavities (lungs, ears, gastrointestinal tract). It may cause air embolism resulting in a stroke or in acute abdominal or spinal cord injury.

**Secondary injury**
Secondary injuries are caused by pieces of flying debris that act as projectiles, resulting in penetrating or blunt injuries. About 10% of these are eye injuries.

**Tertiary injury**
Tertiary injuries occur when the body is thrown by the blast wind and may include fractures, brain injuries, traumatic amputations and other injuries.

**Other injuries**
Other blast trauma injuries may include burns, crush injuries, respiratory (dust/toxins) injuries, and others.

Blast lung is the most common primary blast injury among victims of explosions. It may appear up to 48 hours after the explosion. The acceleration/deceleration process may tear the lung parenchyma off the stationary vascular tree, causing hemorrhage and air emboli. Lung injury may also be induced by smoke inhalation; symptoms include dyspnea, cough, hemoptysis, chest pain, and hypoxia. The initial triad of apnea, bradycardia, and hypotension may occur. Pulmonary injuries that may occur vary
In general, primary blast injury of the lung is manifested as pulmonary contusion. The development of respiratory symptoms and hypoxia may occur in either a fulminant pattern or gradually over the first 48 hours.

Other potential injuries include bronchopleural fistula or arterial air embolism that may be associated with low vascular pressures after hemorrhage or high airway pressures during resuscitation with positive pressure ventilation. Arterial air embolism to the brain or heart may be the most common cause of immediate death from primary blast injury or of death at the moment when positive pressure ventilation is initiated.

Initially, treat all children who have potential pulmonary primary blast injury with 100% oxygen.

Casualties who present with asymmetrically decreased air entry and evidence of shock call for an immediate attempt at needle thoracentesis to decompress a potential tension pneumothorax.

This life-threatening condition may be caused by any combination of primary, secondary, tertiary, or miscellaneous blast injuries.

Acute respiratory distress syndrome (ARDS) may develop within 24 to 48 hours of injury.

**Head injury**
Blast fatalities associated with head injuries are basically related to subarachnoid and subdural hemorrhages. Among survivors, significant traumatic brain injuries are usually easily identified. Remember, however, that mild traumatic brain injuries are common and may be overlooked. Other injuries may also serve to distract the medical provider, making the diagnosis of subtle neurologic findings more difficult. Take into consideration subtle signs and symptoms of potential mild traumatic brain injury, such as memory problems, headaches, fainting, uneven gait, blurred vision, irritability, and confusion.

**Abdominal injury**
Primary intestinal blast injury is uncommon and depends on exposure to a very high air pressure. Injuries may include intestinal petechiae, hemorrhages, large intramural hematomas, intestinal laceration, or bowel perforation. The colon, where gas accumulates, is the most common site of injury. Ruptures may occur acutely or several days later due to stretching, ischemia, and subsequent weakening of the bowel wall. A tension pneumoperitoneum may also occur. Mesenteric, retroperitoneal, or scrotal hemorrhages are other potential injuries.

**Eye injury**
Up to 10% of all blast survivors have eye injuries. Perforations from high-velocity projectiles present as penetrating trauma. Assess patients for altered vision, eye pain,
foreign body sensation, decreased visual acuity, hypema, or lacerations.

**Ear injury**
Blast injuries to the ear can be easily overlooked. Tympanic membrane perforation is the most common injury; however, injuries to the ossicular chain occur in 33% of cases of ear trauma. Inner-ear sensorineural hearing loss may also occur. Blast-related eardrum perforation may have local consequences, including infection, tinnitus, temporary or permanent hearing loss, and vertigo. Such patients need follow-up by otorhinolaryngologist.

**Other injury**
Other injuries associated with blast trauma include compartment syndrome, rhabdomyolysis, acute renal failure, severe burns, and inhalation of toxins. If the explosion occurred in an enclosed space or was accompanied by fire, tests for carboxyhemoglobin and electrolytes, as well as assessment of acid/base status should be performed. Elevated lactate levels are seen in cyanide toxicity.

**Crush injuries**
Building collapse is a common disaster. The collapse of a multistory building may cause crush injury in up to 40% of the extricated survivors. In the Kobe, Japan earthquake of 1995, among the 372 patients with crush syndrome, the mortality rate was about twice that of other trauma patients. Little information exists on children with crush injuries. Children were studied in the aftermath of the 1999 earthquake in Turkey. They showed a pattern of injuries to the ankle (30%), thigh (28.6%), head (23.8%), and forearm (7%). Many had crush syndrome. Surgical amputations and multiple fasciotomies were performed on 12.6% of these children. Acute renal insufficiency occurred in 27% of these children. Modern disaster plans need to anticipate such events.

Even short periods of entrapment can cause muscle compression injuries that

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**BOX 10. Crush syndrome diagnostic criteria**
- Muscle mass involvement
- Prolonged compression (usually 4–6 h, but possibly <1 h)
- Local circulation involvement

Gonzalez D. Crush syndrome. Critical Care Medicine 2003;33-1

**BOX 11. Clinical entities associated with crush syndrome**
- Extreme hypovolemic shock
- Hyperkalemia
- Hypocalcemia
- Metabolic acidosis
- Acute myoglobinuric renal failure
- Compartment syndrome
may result in a crush syndrome, also known as traumatic rhabdomyolysis (Box 10). Crush syndrome is a severe systemic manifestation of trauma and ischemia involving soft tissues, mainly skeletal muscle, due to prolonged severe crushing. It leads to increased permeability of the cell membrane and to the release of potassium, enzymes, and myoglobin from within cells. Ischemic renal dysfunction secondary to hypotension and diminished renal perfusion results in acute tubular necrosis and uremia.

Crush syndrome/traumatic rhabdomyolysis results from muscle reperfusion with subsequent secondary systemic effects. The destruction of muscle tissue and the influx of myoglobin, potassium, and phosphorus into the circulation results in the classic picture of traumatic rhabdomyolysis. The syndrome is characterized by hypovolemic shock and hyperkalemia. It is crucial to initiate volume expansion as soon as possible. Crush syndrome can result in several potential medical conditions that can be associated with significant morbidity or mortality (Box 11).

Patients have classically been described as presenting with muscle weakness, malaise, and fever. This underestimates the real danger that lies in the cardiovascular effects resulting from electrolyte imbalance and renal failure. Look for the physical presence of skin trauma or local signs of compression (erythema, ecchymosis, abrasion, etc.) on the muscle mass. The absence of a pulse or a weak pulse to the distal limbs may be an indicator of muscle swelling or compromised circulation. Continued assessment may demonstrate a pale, cool, diaphoretic limb. Compressed limbs eventually become tense and edematous with compromised vascular circulation. Secondary sensory and motor disturbances in the compressed limbs are commonly seen. Perform a lab evaluation for urine myoglobin, serum creatine phosphokinase, and serum electrolytes.

Key aspects to therapy are volume expansion through intravenous fluid resuscitation, ensuring alkalinized diuresis, and early detection of metabolic abnormalities. Initiate normal saline 20 mL/kg bolus at the scene of disaster or otherwise as soon as possible. Once the patient is hemodynamically stable, switch intravenous fluids to 50% normal saline with 40 mEq sodium bicarbonate for urine alkalinization. A urine pH between 6 and 7 is the goal (Better, 1990).

Diuresis can be forced with the use of either Lasix or mannitol. Lasix (furosemide) is believed to help by causing renal vasodilatation, decreased renal oxygen demands, and increased renal intratubular flow. Mannitol works as an osmotic diuretic and volume expander. Administer analgesics, such as opiates or ketamine.

One of the leading causes of death from crush injuries is severe hyperkalemia (serum potassium >7.0 mEq/L). Hyperkalemia gen-
erates electrocardiographic (ECG) disturbances, such as peaked T-waves, loss of P-waves, and widening of the QRS complex. Treat symptomatic hyperkalemia or hyperkalemia with ECG disturbances with calcium chloride 10% (0.2 mL/kg IV) or calcium gluconate 10% (0.5-1 mL/kg IV); this will stabilize the membrane. Of note, intravenous calcium may be ineffective as a treatment for hyperkalemia if given to a patient with hyperphosphatemia. It may be necessary to consider early dialysis in such patients.

Additional treatment measures include mobilization of potassium into the intracellular space by plasma alkalinization (sodium bicarbonate 1 mEq/kg IV) or glucose administration (0.5-1 g/kg, 25% dextrose in water) plus insulin (0.1 units/kg IV); albuterol aerosol; or kayexalate (sodium polystyrene sulfonate) 1 mg/kg orally or by rectal route. In extreme cases, hemodialysis may be needed (Cronan and Norman, 2000; Gaffar, 2003).

Hypocalcemia is defined as a calcium concentration <9 mg/dL. Clinical presentation includes weakness, paresthesias, and irritability, with ECG findings of prolonged QT interval, bradycardia and arrythmias. Treatment focuses on calcium administration, with continued ECG monitoring and calcium serum level determinations.

Intensive care support often is required for crush syndrome complications. Patients with anuria or oliguria are likely to require hemofiltration or dialysis. Aggressive treatment is necessary to decrease mortality and morbidity. Treatment during the acute phase of the rhabdomyolysis is aimed at maintaining adequate circulating volume and sufficient diuresis to prevent renal, cardiac, and pulmonary complications.

The compartment syndrome occurs when there is an increased pressure in a muscle compartment. This can lead to ischemia with eventual muscle necrosis and nerve damage (palsies). The anterior compartment of the lower leg is the most commonly affected, as there are four susceptible compartments in this commonly injured location. In severe trauma the compartment integrity may actually be disrupted, preventing high intracompartment pressures from being reached. Clinicians should look for increasing and severe pain, especially pain associated with passive extension of the compartment.

The compartment syndrome examination is geared toward the classic description of the “five Ps”:

1. Pain out of proportion for the injury or pain to passive movement of the fingers or toes
2. Pallor of the extremity
3. Paralysis
4. Paresthesias
5. No pulse or reduced pulse

Confirmation of elevated pressures may be obtained by direct measurement of the compartment. Definitive treatment in the presence of a compartment syndrome is surgical release of the compartment connective tissue, i.e. fasciotomy.
Always consider compartment syndrome when the diagnosis of crush syndrome is suspected.

The development of a compartment syndrome in crush injury is due to the uptake of fluid into damaged muscle tissue that forcibly remains within a restricted compartment. Once compartment pressure exceeds capillary perfusion pressure at about 30 to 40 mm Hg, the tissue inside the compartment becomes ischemic and compartment syndrome develops. Although the traditional treatment of the compartment syndrome is fasciotomy, some evidence indicates that initial treatment with mannitol can also decompress a compartment syndrome, avoiding the need for surgery (Better, 1999).
SUMMARY

The prospect of facing a community-wide disaster is daunting even to well-prepared hospitals. No hospital or other organization could be expected to perform effectively during such an event without previous training and practice. Conversely, the amount of relevant training and practice a medical team or facility has had can reflect substantially on its ability to perform well during a crisis.

The potential transfer of a large number of injured or traumatized children requires advance planning. Prior written transfer arrangements with other hospitals should be secured when anticipating mass disaster situations.

Several factors must be considered when preparing to transfer patients to other facilities. The most important is that they are stable for transport. The medical team must also ensure that the airway has been secured if needed, that breathing is not compromised by an untreated pneumothorax or hemothorax, and that circulation issues have been addressed and controlled.

Essential interventions after a disaster include systematic sorting of injured people into different categories (triage), management of trauma by stabilization of the injured individuals, and familiarity with the patterns of the most common lesions.

SUGGESTED READING


American College of Surgeons, Committee on Trauma. Advanced Trauma Life Support. 6th ed., 1997.


Case resolution

Case 1
This patient needs immediate treatment and transport. He has suffered injuries to the thorax, head, and lower extremities. Initial evaluation confirms respiratory distress and shock. Snoring is probably due to airway obstruction by soft tissue, blood, or broken teeth. Adequate positioning of the airway and suctioning may alleviate the problem. Stabilize the cervical spine immediately.

The patient presents with hypoxia, with altered influx of air due to lung contusion or tension pneumothorax.

If the child does not respond to positive pressure ventilation and 100% oxygen, needle decompression of the right hemithorax would be indicated. Also consider endotracheal intubation if oxygenation does not improve with the less invasive airway intervention.

Stabilize the femur by splinting. On the way to the hospital, administer IV fluids for intravascular volume expansion. Quickly refer the patient to a center with pediatric care specialized units.

Case 2
The girl appears to have suffered an isolated head injury with cranioencephalic trauma. Her rapidly deteriorating condition suggests intracranial expansive hematoma, a potentially deadly condition. As in any traumatic brain injury, consider the risk of a spinal-associated lesion. Stabilize the dorsal spine. It is important to be alert to possible vomiting. Administration of 100% oxygen and immediate transport to a center with a neurosurgical pediatric unit—by plane if there is no such facility in the area—are warranted.

On the way to the hospital, place an IV access to administer medication. This is an emergency, and enabling this patient to go immediately into the operating room may make the difference between life and death.
SECTION I - RESPONSE TO A DISASTER

1. What aspects should a plan for a disaster include?
2. How is the rescue personnel organized?
3. What specific equipment is needed for the management of children?
4. What are the major dangers in the disaster scene?
5. What priorities should be considered during transport of a traumatized child?
6. What is the importance of having a standardized system for the classification of patients?

SECTION II - PEDIATRIC TRAUMA ASSESSMENT

1. When managing generalized trauma, what specific differences should be considered with children?
2. What are the steps in the assessment of pediatric trauma?
3. What precautions should be taken when managing a child’s airway?
4. What are the most common traumatic injuries in children?
5. How are thoracic lesions managed in children?

SECTION III - DISASTER-SPECIFIC TRAUMATIC INJURIES

1. How are airways managed in patients with severe burns?
2. How are burns classified?
3. What is the initial care in burn patients?
4. What are blast-related lesions?
5. How is crush syndrome management?
CARVAJAL-GALVESTON FORMULA

- **First 24 hours:**
  5000 mL x BBSA (m²)* + 2000 mL x TBSA (m²)**
  - Ringer’s lactate (half in the first 8 hours and the rest in the following 16 hours)
  - No colloid should be given.

- **Second 24 hours:**
  3750 mL x BBSA (m²) + 1500 mL x TBSA (m²) of dextrose solutions with electrolytes
  (based on patient’s electrolytic anomalies)

*BBSA (burned body surface area): Formula: TBSA x %/100
**TBSA (total body surface area): Formula: (W (kg) x H (cm)/3600)

Notes:
Colloids are recommended at least 12-24 hours after the burn, using albumin poor in salt 1 g/kg/day divided in 3 doses (this aims at maintaining albumin levels above 2.4 g/dL).
If the patient develops myoglobinuria or hemoglobinuria (electrical burns, for example), take the following steps:
- increase fluids administered to achieve a urine output of 3-5 ml/kg/hour
- add bicarbonate to solutions
- if urine output does not improve, add mannitol to therapy
Management of Prevalent Infections in Children Following a Disaster

Stephen Berman | Julia A. Lynch | Ángela Gentile
INTRODUCTION

Morbidity and mortality resulting from an acute humanitarian emergency in developing countries are related to the excessive childhood mortality that existed prior to the disaster. According to the World Health Organization (WHO), children living in low-income countries are 10 times more likely to die before reaching age 5 than children in the industrialized world (Black, 2003; WHO, 1999; Murray, 1996), the main causes of death being pneumonia, diarrhea, measles, malaria, and malnutrition.

During acute humanitarian emergencies, mortality related to those common childhood infections increases due to crowded living conditions; displacement to areas with higher disease prevalence; and compromised personal hygiene resulting from inadequate water supplies, contaminated water, and poor sanitation. The pre-existing nutritional status (particularly micronutrient and vitamin A deficiencies) and immunization rates of children, as well as the pre-existing primary care infrastructure and the degree of damage caused by the disaster, also affect childhood morbidity and mortality after a disaster.
Figure 1 summarizes the causes of death in two refugee camps and illustrates the significance of various illnesses following a disaster.

These stark statistics emphasize the importance of using strategies based on the Integrated Management of Childhood Illness (IMCI) Program, developed to prevent and treat infections during an acute humanitarian emergency.

**Malawi, 1990**
- Malaria: 25%
- Malnutrition: 23%
- Diarrhea: 11%
- Measles: 10%
- ARI: 9%
- Other: 22%

**Sudan, Wad Kowli Camp, 1985**
- Measles: 53%
- Diarrhea: 30%
- ARI: 9%
- Malaria: 7%
- Other: 1%

*ARI: acute respiratory infection
From Famine-affected, refugee, and displaced populations: Recommendations for Public Health issues. MMWR 1992(RR-13); 1-76.*
What is IMCI?
The strategy for the IMCI was designed by PAHO and WHO to enhance children’s health and reduce the mortality and morbidity due to the most prevalent diseases in developing countries.

This strategy includes the early diagnosis, treatment and timely referral of children under 5 years of age with the most common diseases. It also contributes to improving parental skills and practices associated with the home care of children. A community-based approach is essential for childhood health, because it promotes healthy habits in the family.

CASE 1
A 15-month-old boy presents at the emergency department with a fever. He had been healthy until 3 days ago, when he developed symptoms of upper respiratory airway infection. His mother reports giving ibuprofen to her son the day before, because of the fever. The child continues to be febrile with reduced food and fluid intake, urine output, and activity level. There is no history of vomiting, diarrhea, cough, or rash. He is not receiving any medication. You note fatigue and irritability when the child is stimulated during the physical examination. Respiratory rate is 50 breaths/min, pulse rate 162 beats/min, blood pressure 92/70 mm Hg, and axillary temperature 38.9°C. He has dry lips but wet oral mucosa without lesions. His neck is flexible. Lung and heart examination are unremarkable with no significant findings. A few isolated petechiae are noted over the abdomen and lower limbs. Peripheral pulse is normal and capillary refill time is 3 seconds.

- What is your global clinical impression for this boy?
- What is the most probable diagnosis?
- What treatment strategies you should adopt initially?
adequate care of children (feeding, clothing, stimulation, etc.), disease prevention, and prompt seeking of medical care when alarming signs and symptoms are noted. The IMCI strategy also helps healthcare professionals take advantage of opportunities for prevention, promote childhood development, and encourage the rational use of drugs and medications. This strategy is not meant for chronic or less frequent diseases or acute emergencies. As a complement to ambulatory care, this strategy includes procedures and practices at different referral levels and types of hospitals.

The IMCI strategy is based on the importance of simple clinical signs and symptoms, the proper classification of the disease, timely treatment, and interventions for prevention and follow-up. It is particularly useful in the first level of care, i.e., camps, medical offices, health care centers or hospital primary care departments. It includes a series of procedural algorithms and standardized forms to record the patients’ care. Figure 2 shows the algorithm describing the care processes.

**IMCI guidelines**

The practical IMCI guidelines are based on the following principles:

- All sick children must be assessed for general danger signs, which indicate the need for immediate referral or admission to a hospital.
- All sick children must be routinely assessed for major symptoms (for children from 2 months to 5 years old: cough or difficult breathing, diarrhea, fever, ear problems; for infants age 1 week to 2 months: bacterial infection and diarrhea). They must also be assessed for nutritional and immunization status, feeding disorders, and other potential problems.
- Only a limited number of carefully selected clinical signs are used, based on evidence of their sensitivity and specificity to detect diseases. These signs were selected also considering the available resources in first-level health care facilities.
- The combination of individual signs leads to a child’s classification rather than a diagnosis. This classification indicates the severity of the condition and calls for specific actions based on whether the child (a) should be urgently referred to a higher level of care, (b) requires specific treatments, or (c) can be safely managed at home. The classification is color-coded: red requires hospital referral or admission; yellow indicates the need to initiate treatment; and green indicates home management.
- The IMCI strategy addresses most, but not all, of the major reasons why a sick child is brought to a clinic. A child with a chronic condition or a less common illness may require special care. The guidelines do not describe the management of trauma or other acute emergencies due to accidents or injuries.
- IMCI management strategy uses a limited number of essential drugs and encourages the active participation of caregivers in the treatment of children.
- A basic component of the IMCI strategy is the counselling of caretakers about
Assessment of sick children
The assessment procedure for this age group includes a number of important steps that must be taken by the health care provider: (1) Take a history and talk with the caregiver about the child’s problem; (2) check for general danger signs; (3) assess major symptoms; (4) evaluate nutritional status; (5) assess the child’s feeding; (6) check immunization status; and (7) look for other problems.

Danger signs that should be routinely checked in all children
Seizures during the current illness. Seizures may result from fever. Febrile seizures do little harm beyond frightening the parents. But seizures may also be associated with meningitis, cerebral malaria, or other life-threatening conditions. All children with seizures during the current illness should be considered seriously ill.
Unconsciousness or lethargy. An unconscious child is likely to be seriously ill. A lethargic child who is awake but does not take any notice of his/her surroundings or does not respond normally to sounds or movement may also be very sick. These signs can be associated with many conditions, including severe dehydration, severe hypoxia, sepsis, or meningitis.
Inability to drink or breastfeed. An infant may be unable to drink if he/she is too weak or cannot swallow. Observe the child while the mother breastfeeds or gives him/her something to drink.
Persistent vomiting. Vomiting itself may be a sign of serious illness. This symptom may also prevent the child from taking medications or fluids for rehydration.

A child with one or more of these signs must be considered seriously ill and will require hospital referral. To start treatment for severe illnesses without delay, quickly assess the child for the most important causes of serious illness and death, including acute respiratory infection (ARI), diarrhea and dehydration, sepsis, malaria, and measles. A rapid assessment
**FIGURE 2.** Summary of the process of integrated care of children

**For all sick children age 1 week up to 5 years who are brought to a first-level health facility**

**ASSESS** the child: Check for danger signs (or possible bacterial infection). Ask about main symptoms. If a main symptom is reported, assess further. Check nutrition and immunization status. Check for other problems.

**CLASSIFY** the child's illnesses: Use a color-coded triage system to classify the child's main symptoms, and his or her nutrition or feeding status.

**IF URGENT REFERRAL** is needed and possible

**IDENTIFY URGENT PRE-REFERRAL TREATMENT(S)** needed for the child's classifications

**TREAT THE CHILD:** Give urgent pre-referral treatment(s) needed

**REFER THE CHILD:**
- Explain to the child's caretaker the need for referral.
- Calm the caregiver's fears and help solve any problems.
- Write a referral note addressed to the hospital.
- Give instructions and supplies needed to care for the child on the way to the hospital.

**IF NO URGENT REFERRAL** is needed or possible

**IDENTIFY TREATMENT** needed for the child's classifications: Identify specific medical treatments and/or advise

**TREAT THE CHILD:** Give the first dose of oral drugs in the clinic and/or advise the child's caregiver. Teach the caretaker how to give oral drugs and how to treat local infections at home. If needed, give immunizations.

**COUNSEL THE MOTHER:**
- Assess the child's feeding, including breastfeeding practices, and solve feeding problems, if present.
- Advise about feeding and fluids during illness and when to return to a health facility.
- Counsel the mother about her own health.

**FOLLOW-UP CARE:** Give follow-up care when the child returns to the clinic and, if necessary, reassess the child for new problems.
FIGURE 3. IMCI strategy for case management in the outpatient health care facility, first-level referral service, and at home for the sick child from age 2 months to 5 years

THE INTEGRATED CASE MANAGEMENT PROCESS

OUTPATIENT HEALTH CARE FACILITY

Check for DANGER SIGNS
• Seizures
• Lethargy/unconsciousness
• Inability to drink/breast-feed
• Vomiting

Assess MAIN SYMPTOMS
• Cough/difficult breathing
• Diarrhea
• Fever
• Ear problems

Assess NUTRITION, IMMUNIZATIONS and POTENTIAL FEEDING PROBLEMS

Check for OTHER PROBLEMS

CLASSIFY CONDITIONS and IDENTIFY TREATMENT ACTIONS
According to color-coded treatment

RED
Urgent referral
OUTPATIENT HEALTH CARE FACILITY
• Pre-referral treatments
• Counsel parents
• Refer child

YELLOW
Treatment at outpatient health care facility
OUTPATIENT HEALTH CARE FACILITY
• Treat local infection
• Give oral drugs
• Counsel and teach caretaker
• Follow-up

GREEN
Home management
HOME
Caregiver is counselled on:
• Home treatment(s)
• Feeding and fluids
• When to return immediately
• Follow-up

REFERRAL FACILITY
• Emergency Triage and Treatment (ETAT)
• Diagnosis
• Treatment
• Monitoring and follow-up
What is the impact of measles?
A measles outbreak is potentially devastating in displaced populations. In many parts of the developing world, measles is one of the leading causes of childhood morbidity and mortality: it is highly contagious and spreads through aerosolized particles from respiratory secretions containing the virus. Measles fatalities vary from 200,000 to 800,000 per year in developing countries (Black 2003; WHO 1999 and 2001; Murray 1996). While case fatality rates (CFR) for all measles infections are less than 0.1% in developed countries, in developing countries the rates exceed 1% to 2%. CFRs for hospitalized cases have been reduced by the use of vitamin A treatment.

In developing countries, mortality from measles is related to the intensity of the exposure and host’s nutritional and immunologic status. Secondary cases within a household are at greater risk than index cases. Knowing the level of measles vaccination coverage in the affected community and the frequency of measles cases diagnosed within the past few years is helpful. If measles cases have been diagnosed in the community within the past several years, plan a measles immunization campaign, regardless of the immunization coverage level.

Give measles vaccination high priority in a large displaced or refugee population because there may be enough susceptible children to cause an epidemic. Malnourished children living in crowded shelters following a disaster are especially vulnerable and at high risk for severe disease. Implement a surveillance system to identify possible measles cases in the camp or area. Educate medical staff about the clinical signs that suggest measles, such as fever, cough, conjunctivitis, and rash. Respiratory syndromes are often nonspecific; measles cases can be easily overlooked and other respiratory infections can be mistaken for measles.
Importance of vaccination

Unfortunately, isolation of patients is not an effective preventive measure since individuals are most contagious in the prodromal period, before a diagnosis can be made. The only effective approach is to vaccinate the population as soon as possible. Give measles vaccination the highest priority early in disaster situations. Do not delay until cases of measles have been reported (Box 2) (CDC, 1992).

Consider vaccinating children presenting with acute illness, such as fever, diarrhea, and ARI, as well as malnourished children and those with tuberculosis or HIV infection.

Vitamin A and measles

Vitamin A deficiency increases measles-associated morbidity and mortality. Moreover, measles infection increases the severity of the complications resulting from vitamin A deficiency. Vitamin A is important in maintaining epithelization of the respiratory tract and in the recovering process after infection. It also plays a key role in the body’s immune defenses. Children deficient in vitamin A who become infected with measles have higher corneal ulceration and fatality rates. Develop a plan to administer prophylactic vitamin A in conjunction with a measles immunization program. However, when measles vaccine is not yet available and a delay is anticipated, administer vitamin A. This vitamin by itself reduces morbidity and mortality during measles outbreaks. The prophylactic dose of vitamin A according to World Health Organization current recommendations is 100,000 IU for infants and 200,000 IU for children older than 12 months. Pregnant women should receive only 30,000 IU of vitamin A.

Measles diagnosis

Following an incubation period of 10 to 12 days from exposure, measles prodrome is characterized by 2 to 4 days of fever, cough, coryza, and conjunctivitis. During this period, Koplik spots can be seen as tiny blue-white spots on an intensely reddened oral mucosa. These lesions disappear within 3 days. The maculopapular erythema or morbilliform rash of measles
first appears on the hairline and forehead, then moves downward to involve the face, neck, and the rest of the body. Initially the lesions are discrete and then become confluent. If no complications occur, fever disappears within 2 to 3 days after the onset of rash. The rash persists for 4 to 6 days. It becomes brownish in color for a few days before desquamating. Many children have anorexia, and some have mild stomatitis. Generalized lymphadenopathy can occur, but it is uncommon.

**Measles complications**

Measles is a highly catabolic disease, associated with reduced food intake, increased gastrointestinal losses, and rapid weight loss. Complications occur in approximately 30% of cases; complication rates are even higher in developing countries. The most frequent acute complications are pneumonia, croup, otitis media, and diarrhea. Measles virus is immunosuppressive and predisposes to secondary viral and bacterial infections, as well as to the reactivation of tuberculosis.

Malnourished children often have atypical presentations that may vary from hemorrhagic lesions associated with mucosal bleeding and disseminated intravascular coagulation (called black measles), to a less intense rash because of compromised cell-mediated immunity. These children may also have a deeper desquamation resulting in extensive areas of depigmentation. Providing nutritional support continued feeding, even if diarrhea is present, is crucial. If the child refuses feeding, consider using a nasogastric tube. Give additional fluids to prevent or treat dehydration. When acute infection has resolved, enroll malnourished children in a feeding program, if available.

Most measles-related deaths are associated with pneumonia, croup, and diarrhea. Rare acute complications include encephalitis and endocarditis. Major long-term sequelae in developing countries include measles-related blindness, malnutrition, and chronic lung disease. The immunosuppressive effect of measles may delay recovery for many months and cause recurrent infections and later death.

**Classification**

Measles is classified according to the severity of the illness. Refer severe or very severe cases to a hospital (Hussey and Berman, 2003).

**Mild:** Fever resolves within 4 days and rash within 8 days with no sign of complications.

**Moderate:** There are signs of secondary bacterial upper respiratory infection: acute otitis media, sinusitis, or cervical adenitis.

**Severe:** Signs of respiratory distress emerge with tachypnea, indrawing, reduced oxygen saturation, or stridor. Other possible signs are heart murmurs or electrocardiographic changes, ophthalmologic signs of vitamin A deficiency or corneal ulcerations, deep or extensive mouth ulcers, bloody diarrhea, jaundice, abdominal pain, moderate to severe dehydration, or purpura (hemorrhagic
measles). Patients with severe malnutrition, immunodeficiency disorders, cardiopulmonary disorders, or pre-existing tuberculosis are most at risk.

**Very severe:** Patient exhibits any of the following symptoms: altered mental status with coma, seizures, or focal neurologic signs; shock with poor peripheral perfusion; upper airway obstruction or signs of respiratory failure; signs of congestive heart failure; or acute abdominal pain with peritoneal signs.

**How can complications of measles be prevented?**
Administer vitamin A 100,000 IU to infants and 200,000 IU to children older than 12 months. Repeat the dose in 24 hours. For patients with ophthalmologic signs of vitamin A deficiency (xerosis, Bitot's spots, keratomalacia, corneal ulceration, or clouding) repeat the dose in 4-6 weeks to prevent corneal ulceration.

Severe mouth ulceration can be a consequence of herpes infection and may contribute to reduced fluid and food intake. Promote oral hygiene with regular mouth washes using clean water and the application of local antiseptic solutions. Consider gentian violet to treat mouth ulcers.

Prevent secondary eye infections through regular cleansing of the eyes with water and topical antibiotics, such as tetracycline. Consider a protective eye pad to prevent secondary infection.

If dysentery is present, treat with an appropriate antibiotic therapy for *Shigella.*
ACUTE RESPIRATORY INFECTIONS

OBJECTIVES

- Know the three key clinical signs used to assess a child with cough or difficult breathing and based on these signs, classify acute respiratory clinical illness into three categories.
- Diagnose and develop a treatment plan (medications, supportive care, and monitoring) using available resources for patients with:
  - Severe pneumonia
  - Pneumonia
  - Upper respiratory infection
  - Ear problem without pneumonia

Acute respiratory infections: The patient with cough or difficult breathing

All types of respiratory infections are more common among people living in overcrowded conditions in developing countries. Most cases of acute respiratory infections (ARI) are viral upper respiratory tract infections that should not be managed with antibiotics. The IMCI strategy uses 3 key clinical signs to assess children with cough or difficult breathing:

- **Respiratory rate (RR)** distinguishes the presence or absence of pneumonia.
- **Lower chest wall indrawing** indicates severe pneumonia.
- **Stridor** in a calm child indicates severe upper airway obstruction and the need for hospital admission.

CASE 2

A 3-month-old infant presents with fever, restlessness, and poor food intake. He is irritable and it is difficult to soothe him. He is breathing normally. His vital signs include respiratory rate 36 beats/min, heart rate 120 beats/min, blood pressure 90/58 mm Hg, temperature 102°F (39.2°C), and oxygen saturation 98%. The fontanelle looks full and the neck is flexible. Capillary refill time is 2 seconds.

- Which of these findings are consistent with the diagnosis of meningitis?
- Which is the most important therapeutic measure to be implemented?
- Which complications could possibly occur?
Respiratory rate
No single clinical sign has a better combination of sensitivity and specificity to detect pneumonia in children under 5 years than RR. Even auscultation by an expert is less sensitive as single sign. Cutoff rates for fast breathing (tachypnea) depend on the child’s age. Normal RR is higher in children aged 2 to 12 months than in children from 12 months to 5 years (Table 1).

The specificity of RR for detecting pneumonia depends on the prevalence of bacterial pneumonia among the population. In areas with high levels of viral pneumonia, RR has relatively modest specificity. Nevertheless, even if the use of RR leads to some over-treatment, this will still be small compared with the use of antibiotics among all children with an ARI, as frequently occurs.

Lower chest wall indrawing
Lower chest indrawing is defined as the inward movement of the bony structure of the chest wall with inspiration. It is a useful marker of severe pneumonia. It is more specific than “intercostal indrawing,” which includes the soft tissue between the ribs without affecting the bony structure of the chest wall. Chest indrawing should only be considered present if it persists in a calm child. Agitation, a blocked nose, or breastfeeding can all cause temporary chest indrawing.

Stridor
Stridor is a harsh noise made when the child inhales. Children who present with stridor when calm are at substantial risk of upper airway obstruction and should be referred. Some children with mild croup manifest stridor only when they are crying or agitated.

Wheezing
Sometimes a wheezing noise is heard at exhalation. Wheezing is usually associated with asthma or viral bronchiolitis. With fast breathing, no distinction is made between children with bronchiolitis and those with pneumonia.

In some cases, especially when a child has wheezing at exhalation, the final decision on presence or absence of fast breathing can be made after a test with a rapid-acting bronchodilator (if available). Experience suggests that even where asthma rates are high, mortality from asthma is relatively uncommon.

<table>
<thead>
<tr>
<th>Child’s age</th>
<th>Cutoff rate for fast breathing (tachypnea)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 months to 12 months</td>
<td>50 breaths per minute or more</td>
</tr>
<tr>
<td>12 months to 5 years</td>
<td>40 breaths per minute or more</td>
</tr>
</tbody>
</table>

No single clinical sign has a better combination of sensitivity and specificity to detect pneumonia in children under 5 years than respiratory rate.
Classification of children with cough or difficult breathing

Based on a combination of the aforementioned clinical signs, children presenting with cough or difficult breathing can be classified into 3 categories: those who require referral for possible severe pneumonia or very severe disease, those who require antibiotics as outpatients, and those who do not require antibiotic treatment (Box 3).

The group requiring referral for possible very severe disease includes children with any general danger sign, lower chest indrawing, or stridor when calm. Children with severe pneumonia or very severe disease are more likely to have life-threatening invasive bacterial infections. This indicates the need to use injectable antibiotics.

Give outpatient antibiotics to children with a fast RR for their age to treat bacterial pneumonia when they do not have additional danger or severe signs. Fast breathing, as defined by WHO, detects about 80% of children with pneumonia who need antibiotic treatment. Treatment based on this classification has been shown to reduce mortality.

Patients with cough and no signs suggesting pneumonia or severe disease do not require antibiotics. Such children may require a safe agent to relieve cough. A child with cough will normally improve in 1 to 2 weeks. However, a child with chronic cough (more than 30 days) needs to be further assessed (and, if needed, referred) to rule out tuberculosis, asthma, whooping cough, or another respiratory problem (Mulholland et al., 1992).

Antibiotics

First-line oral antibiotics for suspected pneumonia will typically be amoxicillin or cotrimoxazole (trimethoprim-sulfamethoxazole). Intramuscular (IM) antibiotics used to treat severe pneumonia or very severe disease include chloramphenicol, benzylpenicillin, and ceftriaxone. IM chloramphenicol (40 mg/kg every 12 hours) is commonly used for serious infections when oral agents cannot be administered. Bear in mind that there is no pharmacologic value to giving IM or intravenous (IV) chloramphenicol instead of the oral agent in terms of achievable blood levels (Sazawal and Black, 1992).
**Ear problems**

Ear problems are the next condition that should be checked in all children brought to the outpatient health care facility. A child presenting with an ear problem should first be assessed for general danger signs, cough or difficult breathing, diarrhea, and fever. Although otitis is rarely a cause of death, it is the main cause of deafness in low-income areas, which in turn leads to learning problems.

**Clinical assessment**

When otoscopy is not available, examine the child for the following clinical signs:

- **Tender swelling behind the ear.** The most serious complication of an ear infection is an infection in the mastoid bone (mastoiditis). It usually manifests with swelling behind one of the ears. In infants, this swelling may also be above the ear. When present, this sign is considered positive and should not be mistaken for swollen lymph nodes.

- **Ear pain.** In the early stages of acute otitis, a child may suffer ear pain, which usually causes the child to cry and become irritable.

- **Ear discharge.** This is another sign of an ear infection.

**Classification of ear problems**

Based on the presence and duration of clinical signs (swelling behind the ear, ear pain or ear discharge), the child’s condition can be classified as mastoiditis, acute otitis, or chronic otitis (Box 4).

Children presenting with swelling of the mastoid bone are classified as having mastoiditis and should be referred to a hospital for treatment. Before referral, these children should receive a dose of antibiotics and a single dose of paracetamol for pain.

Children with ear pain or ear discharge for less than 14 days are classified as having acute otitis. Treat them for 5 days with the same first-line antibiotic as for pneumonia. If there is ear discharge for more than 14 days, the child’s classification is chronic otitis. Attempt to wick or dry up the ear. In this case antibiotics are not recommended because they are expensive and their efficacy is not proven.

If no signs of ear infection are found, children are classified as having no ear infection and do not require any specific treatment.

**Box 4. Classification of ear problems**

<table>
<thead>
<tr>
<th>Mastoiditis</th>
<th>Acute otitis</th>
<th>Chronic otitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Tender swelling behind the ear</td>
<td>– Ear discharge for less than 14 days</td>
<td>– Ear discharge for more than 14 days</td>
</tr>
<tr>
<td></td>
<td>– Ear pain</td>
<td></td>
</tr>
</tbody>
</table>

No ear infection

– No ear pain or discharge

When otoscopy is not available, examine the child for clinical signs, such as swelling behind the ear, ear pain, and ear discharge.
Malaria is caused by a protozoan blood parasite (*Plasmodium*) transmitted by the *Anopheline* mosquito as a vector. The infection produces a clinical syndrome that ranges in severity depending on the species of the parasite and the immune status of the individual. Malaria caused by *Plasmodium vivax*, *P. malariae*, and *P. ovale* usually results in mild or moderate disease. *P. falciparum* often results in a life-threatening disease and severe anemia. The emergence of multidrug-resistant *P. falciparum* is a global problem.

Worldwide there are 300 million new cases of malaria each year and 1 to 2 million deaths. Most deaths occur in children under 5 years of age. Most susceptible individuals to severe, fatal malaria include infants and young children, malnourished children, and pregnant women.

Children who have been recently treated for malaria can contract malaria again. Malaria immunity following an infection is at best partial, and protects only against the species causing the initial infection. Children can therefore be infected with a different malaria species in regions having more than one prevalent species or they can be reinfected with the same species. A relapse or recrudescence of an existing infection can be related to a failure to eradicate a parasite that has become drug-resistant or to a patient’s failure to adhere to a therapeutic regimen.
Malaria occurs in areas of Southeast Asia and Latin America where transmission is seasonal or limited to specific focal areas, so the general population does not have a high level of acquired immunity. Both children and adults in these areas are at high risk for severe disease. Malaria also occurs in areas of Africa where the disease is widespread and endemic. It generates high levels of acquired immunity in adults, but young children are at higher risk for severe disease. Most Anopheles mosquitoes are not well adapted to urban environments or places about 3,900 ft (1,200 m) above sea level. Consequently, individuals living within a malaria endemic country may be nonimmune if they live within one of these malaria-free “pockets.” When these nonimmune people are displaced from their communities to areas with high malaria transmission, the consequences can be devastating.

Malaria diagnostic tests
Malaria infection is diagnosed by identifying the parasite in stained (Giemsa or Wright) blood smears. A blood sample is easily obtained from a finger prick. After a drop is placed on a clean labeled glass slide, spread it with another glass slide into a thin blood smear. Thick smears are obtained by placing some drops of blood on a glass slide and spreading the drops with the corner of another glass slide. Dry the resulting smear without fixation. Since thick smears allow the examination of more blood than thin smears, they facilitate the detection of the parasite in cases of low-grade parasitemia. New rapid diagnostic tests for malaria have been developed and will become more widely available in the future.

Children suspected of having malaria should have thick and thin smears of peripheral blood done whenever possible. Serial samples at 6- to 12-hour intervals for 48 hours may be necessary to identify the parasite. Species identification in the field setting is important only for discriminating between *P. falciparum* and other species because the treatment can be different. *P. vivax*, *P. ovale*, and *malariae* are all sensitive to chloroquine and produce less severe disease than *P. falciparum*.

The quantitative level of parasitemia is a prognostic marker; >5% of parasitized red blood cells is associated with high mortality. Low-grade parasitemia related to partial immunity or treatment can result in a negative smear. Even patients with cerebral malaria can be smear-negative at presentation.

Therefore, when the clinical history and presentation suggest malaria, begin treatment regardless of the presence of parasites on the smears. If experienced laboratory technicians and equipment are not available, then the diagnosis and treatment of malaria must be based on the presence of clinical signs and symptoms consistent with malaria and the knowledge of local malaria prevalence.

However, it is also important to acknowledge that malaria can coexist with other conditions that cause fever. In
the absence of specific diagnostic tests, empiric treatment of any serious febrile illness should include coverage for malaria, as well as other pathogens. Remember: fever in a malaria endemic area should be considered caused by malaria unless another cause is identified.

**Surveillance**

In areas with endemic malaria, determine the proportion of febrile illness in a camp or settlement attributable to malaria by comparing thick (and thin, if possible) blood smears from a sample of patients under 5 years of age who have a history of recent fever with an equal number of patients without fever. Comparing the prevalence of malaria parasites in the blood of these two groups gives an indication of how much malaria is contributing to acute febrile illness in the general population. This will be useful for the empiric management of other patients.

**Chemoprophylaxis**

Chemoprophylaxis for malaria is rarely feasible in the acute emergency setting. It has been used to limit epidemics in groups without immunity that are relocated to a high malaria transmission area and to reduce mortality among targeted populations, such as malnourished children under 5 years of age.

Adequate infrastructure and resources must be available to implement a preventive chemoprophylaxis program for a targeted population. Efforts must be coordinated with local and national public health authorities.

**Clinical presentation**

There are two distinct clinical malaria presentations: typical uncomplicated malaria and severe, complicated malaria. Typical uncomplicated malaria presents with fever, chills, headaches, myalgias, diarrhea, and anemia. Classic malaria fever has been described as paroxysms of fevers and shaking chills lasting 8 to 12 hours, every 2 to 3 days. During the afebrile period, fever disappears and the subject feels relatively well (depending on the species). The febrile paroxysms coincide with the cyclical release of parasites from ruptured red blood cells; the afebrile period coincides with the quiet growth of the parasite in a new population of red blood cells. Partially immune individuals may have a non-specific fever pattern.

Malaria is considered to be very severe if parasitemia is >5% or any of the following complications is present: severe anemia associated with hemoglobinemia, bleeding diathesis, hypotension and shock, renal failure, hypoglycemia, acidosis, or encephalopathic signs (cerebral malaria). Cerebral malaria is associated with signs of acute encephalopathy (coma and seizures), normal cerebrospinal fluid (CSF), and no other identifiable cause (meningitis, viral encephalitis, metabolic abnormalities). Cerebral malaria mortality varies from 15% to 50% (Table 2).

**Treatment of typical uncomplicated malaria**

The treatment of malaria depends on the likelihood of a malaria infection and the
### TABLE 2. Degree of illness in malaria

<table>
<thead>
<tr>
<th>Moderate</th>
<th>Severe</th>
<th>Very Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache, malaise, irritable (can be soothed)</td>
<td>Irritable and not easily soothed, poor eye contact (lethargic), feeds poorly</td>
<td>Unresponsive, too weak to feed, or extreme weakness or seizures</td>
</tr>
<tr>
<td>or</td>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td>Parasitemia &lt;2%</td>
<td>Signs of mild or moderate dehydration but good peripheral perfusion</td>
<td>Signs of severe dehydration with shock, poor peripheral perfusion with cold, mottled extremities, capillary refill &gt;2 seconds, low blood pressure</td>
</tr>
<tr>
<td>WITHOUT SIGNS OF</td>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td>• Dehydration</td>
<td>Pallor but no signs of severe anemia or bleeding</td>
<td>Signs of respiratory distress or pulmonary edema with respiratory rate &gt;60, cyanosis, or respiratory failure</td>
</tr>
<tr>
<td>• Respiratory distress or pulmonary edema</td>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td>• Severe anemia</td>
<td>Parasitemia &gt;2% and &lt;5%</td>
<td>Severe normocytic anemia, hemoglobinuria, or bleeding associated with disseminated intravascular coagulation</td>
</tr>
<tr>
<td>• Bleeding or a metabolic disorder</td>
<td>But</td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>No signs of respiratory distress, pulmonary edema, severe anemia, or a metabolic disorder</td>
<td>Metabolic disorder, hypoglycemia, metabolic acidosis, or renal failure</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>Parasitemia ≥5%</td>
<td>Parasitemia ≥5%</td>
</tr>
</tbody>
</table>
risk of chloroquine-resistant *P. falciparum* or *P. vivax*, the severity of the infection, the setting, and the availability of drugs. In high-risk areas, treat all forms of typical uncomplicated malaria not caused by *Plasmodium falciparum* with oral or nasogastric chloroquine phosphate (except for chloroquine-resistant parasites). Primaquine is effective at preventing relapses because it eradicates the liver stages of *P. vivax* and *P. ovale* that persist in patients who have experienced the acute illness. This drug is not normally used in disaster situations.

In low-risk areas or areas with seasonal malaria, only treat children presenting with fever with no other identified cause (acute respiratory infection, ear infection, pharyngitis, measles, etc.). However, the persistence of fever longer than 5 days requires reassessment and, if possible, laboratory testing for malaria. The management of all forms of *Plasmodium falciparum* now recommended by the WHO since 2008, given the increasing resistance to chloroquine shown by these organisms, is a new first line therapy that replaces classical chloroquine phosphate: artemisinin-based agents. There are combination therapies and non-combination therapies, but the first are recommended. They are given orally for 3 days.

1. Combination therapies (2 drugs in one tablet)
   - artemether-lumefantrine (Coartem®) (Table 3)
   - artesunate + mefloquine
   - artesunate + amodiaquine

2. Non-combination therapies (Table 4)
   - artesunate (4 mg/kg once a day for 3 days) + mefloquine (25 mg/kg base divided in 2 doses on the second and third days)
   - artesunate (4 mg/kg once a day for 3 days) + SP (sulfadoxine 25 mg/kg + pirimetamine 1.25 mg/kg as a single dose on day 1) in areas where cure rate with SP is higher than 80%
   - artesunate (4 mg/kg once a day for 3 days) + amodiaquine (10 mg bse/kg/day for 3 days) in areas where cure rates with amodiaquine as single therapy are higher than 80%

### TABLE 3. Dosage schedules for artemether-lumefantrine

<table>
<thead>
<tr>
<th>Weight (approx. age)</th>
<th>Number of tablets at approximate timing (hours) of dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 h</td>
</tr>
<tr>
<td>5-14 kg (&lt;3 years)</td>
<td>1</td>
</tr>
<tr>
<td>15-24 kg (&gt;3-8 years)</td>
<td>2</td>
</tr>
<tr>
<td>25-34 kg (&gt;9-13 years)</td>
<td>3</td>
</tr>
<tr>
<td>&gt;34 kg (&gt;14 years)</td>
<td>4</td>
</tr>
</tbody>
</table>

If the abovementioned drugs are not available, recommended therapy continues to be chloroquine phosphate. For children, a total dose of 25 mg/kg of chloroquine over a 3-day period; 10 mg base/kg (maximum 1 g = 600 mg base), then 5 mg base/kg 6 hours later; 5 mg base/kg/dose at 24 and 48 hours. For adults, 1 g (600 mg base), 500 mg (300 mg base) 6 hours later; then 500 mg (300 mg base) at 24 and 48 hours.

Chloroquine-resistant strains of *P. falciparum* are common throughout many regions of the world. When the proportion

---

**TABLE 4.**

**Dosage schedules for artesunate + mefloquine**

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of artesunate tablets (50 mg) per day</th>
<th>Number of mefloquine tablets (250 mg base) per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 2</td>
</tr>
<tr>
<td>5-11 months</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>&gt;1-6 years</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>&gt;7-12 years</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>&gt;13 years</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Dosage schedules for artesunate + SP**

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of artesunate tablets (50 mg) per day</th>
<th>Number of SP tablets (25 mg S + 500 mg P base) per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 2</td>
</tr>
<tr>
<td>5-11 months</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>&gt;1-6 years</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>&gt;7-12 years</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>&gt;13 years</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Dosage schedules for artesunate + amodiaquine**

<table>
<thead>
<tr>
<th>Age</th>
<th>Artesunate tablet (50 mg)</th>
<th>Amodiaquine tablet (153 mg base)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 2</td>
</tr>
<tr>
<td>5-11 months</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>&gt;1-6 years</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>&gt;7-12 years</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>&gt;13 years</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

of chloroquine-resistant *P. falciparum* is less than 25%, it may be reasonable to use chloroquine as first-line treatment in less severe patients and assess the response. Failure to respond in 48 to 72 hours indicates infection with a resistant strain. Treat children with chloroquine-resistant *P. falciparum* uncomplicated malaria with quinine sulfate 25 mg/kg/day tid for 3 to 7 days (depending on resistance patterns to quinine) plus one of the following:

- Doxycycline 2.2 mg/kg/day for 7 days (adult dose 100 mg bid for 7 days)
- Tetracycline 25 mg/kg/day qid for 7 days (adult dose 250 mg qid for 7 days)
- Clindamycin 20 mg/kg/day tid for 7 days (adult dose same as for children)

Treat children who may have acquired malaria in Southeast Asia (Thailand) and East Africa with quinine for 7 days, because of the presence of multiple resistant strains in these areas. Additional alternative therapies for resistant *P. falciparum* include atovaquone-proguanil, mefloquine, halofantrine (associated with heart-related side effects), and artemunate. See appendix for Centers for Disease Control and Prevention (CDC) actual recommended treatment options.

Assume all severe, complicated malaria infections are caused by resistant *P. falciparum* strains unless proven otherwise. Chloroquine is effective and safe for treating pregnant women. This is important because malaria during pregnancy is more severe and can be fatal. Ideally, use supervised therapy. Observe administration of at least the first dose to be sure that it is not vomited.

If chloroquine phosphate is not available, hydroxychloroquine sulfate is also effective, but in this case 400 mg of hydroxychloroquine are equivalent to 500 mg of chloroquine phosphate.

In several regions mixed infection with species of *P. falciparum* and *P. vivax* commonly occurs. If diagnosis of infection is based solely on clinical data, therapy must cover both types of parasites. In the acute phase of an emergency, the detection of a *P. falciparum* infection is a priority and artemisinin-based agents (except artemesunate SP) are effective against both organisms.

Supportive management of uncomplicated malaria includes antipyretics, oral rehydration solution (ORS), assessment, and possible referral to a feeding program for malnutrition. Successfully treated patients should improve by 48 hours and be symptom-free by 72 hours. If symptoms persist after 3 days, obtain a new blood smear and consider the possibility of chloroquine-resistant malaria or an alternative cause for the fever.

**Treatment of severe and complicated malaria**

Assume that all severe, complicated malaria infections are caused by resistant *P. falciparum* strains unless proven otherwise. Children with severe, complicated malaria can deteriorate rapidly, so initiate treatment with the best available drug and, if possible, arrange a transfer to a hospital for intravenous (IV) therapy (see appendix).

As from 2008, given the increasing chloroquine resistance mentioned above, the first line treatment for severe malaria recommended by the WHO is based on
artemisinin derivatives, such as:
• IM artemether
  Intramuscular (IM) loading dose (3.2 mg/kg) as a single dose on day 1
  Maintenance dose (1.6 mg/kg) IM until the child tolerates oral therapy
• Intravenous (IV) or IM artesunate
  IV loading dose (2.4 mg/kg) over 3 minutes as a single dose on day 1, at 0, 12 and 24 hours
  Maintenance dose (2.4 mg/kg) over 3 minutes, starting on day 2, once a day, until the child tolerates oral therapy
• Rectal artesunate, only if IV or IM routes are not feasible
  Administer rectal artesunate 10 mg/kg in a suppository. Repeat the dose if the drug is eliminated within the first hour. Repeat the dose in 24 hours if the patient can not be transferred to the hospital. Artesunate suppositories remain stable at temperatures of up to 40 degrees and, therefore, require warm, not cold, temperatures for transportation and storage.
  After IM or IV therapy, the patient should be switched to oral therapy; the recommended agent in this case is artemether-lumefantrine (Coartem®) during three days.
  If first-line drugs were unavailable, an option is quinine dihydrochloride. A loading dose of 20 mg/kg in 10 mL/kg of 5% dextrose should be administered IV over 4 hours, followed by 10 mg/kg over 4 hours (maximum 1,800 mg/kg) until oral therapy can be started (see Appendix). Blood glucose monitoring for hypoglycemia is recommended every 4 hours after each loading and maintenance infusion. If IV quinine is required for more than 48 hours, maintenance dose should be reduced to 7 mg/base/kg. It is extremely important to bear the infusion volume into account. In order to avoid volume overload due to the IV administration of liquid, the quinine infusion volume should be included in the estimation of daily liquid requirements.
  Quinine can be diluted in 5% glucose solution, 10% glucose, 4% glucose, 0.18% saline or 0.9% normal saline. It should be diluted to a total volume of 10 mL/kg (the same volume should be used both for the loading dose and the maintenance dose) and infused over 4 hours. After a minimum of three IV doses of quinine, the patient should be switched to oral therapy. Therapy options by this route include: artemether-lumefantrine (Coartem®) over 3 days, or oral quinine 10 mg base/kg, every 8 hours, until a 7-day course is completed. In areas of multiple resistant malaria, quinine should be combined with oral clindamycin, 5 mg/kg 3 times a day, during 7 days. Mefloquine should be avoided in children that have been in coma, since it increases the risk of neuropsychiatric complications.
  A third choice is administering an initial dose of quinine sulfate by oral route or nasogastric tube until IV therapy is available. If the patient vomits, repeat the dose within 30 minutes. If vomits persist, start IM quinidine 10 mg/kg every 4 hours until the patient is transferred to a hospital for IV therapy. At the hospital, treat very severely ill patients with an IV loading dose of quinine gluconate 10 mg/kg administered over 1 to 2 hours, then with a 0.02 mg/kg/min continuous infusion until oral therapy can be given. If possible, measure hemoglobin,
blood sugar, and perform blood and cerebrospinal fluid (CSF) cultures.

Treat children with severe complicated malaria with antibiotics for potential bacteremia or meningitis pending the results of blood and CSF cultures. If possible, monitor the patient for electrocardiographic changes (QT interval, arrhythmias), cinchonism (tinnitus, nausea, headache, and visual changes), and hypoglycemia. Discontinue IV quinidine as soon as the child has improved and switch to oral or nasogastric quinine to complete a 3 or 7 day course (varies by region).

Indications for exchange transfusion vary according to the quality of intensive care facilities and availability and safety of blood products. The theoretical benefits of an exchange transfusion are parasitemia reduction, correction of anemia, improved oxygenation, and enhanced capillary blood flow. It is recommended when children have signs of very severe illness with parasitemia >10%.

Supportive treatment of severe, complicated malaria includes antipyretics and oral rehydration solution (ORS). Monitor signs that suggest fluid overload causing pulmonary or cerebral edema. Additional sugar may be added to the ORS because of the risk for hypoglycemia.

Initial treatment of seizures with 50% dextrose is recommended, followed by phenobarbital (10 mg/kg IM) if seizures persist.

**Dengue**

Dengue infections occur worldwide but are most prevalent in Southeast Asia, although an important outbreak has occurred in Central and South America. In Southeast Asia, outbreaks of hemorrhagic fever occur cyclically every 4 to 5 years. It is caused by an arbovirus, usually acquired by the bite of Aedes mosquitoes. There are 4 closely related serotypes of dengue virus, all of which can cause severe disease.

Dengue fever is a mild, self-limited febrile episode that is associated with rash. It begins with fever, respiratory symptoms (sore throat, coryza, cough), anorexia, nausea, vomiting, and headache. Back pain, myalgias, arthralgias, and conjunctivitis are less frequent symptoms. The initial fever resolves within approximately 1 week, and a generalized morbilliform or maculopapular rash develops a few days later. Fever often returns with the rash (Table 5).

**Dengue hemorrhagic fever (DHF grades I and II)** is characterized by hemoconcentration, thrombocytopenia, and coagulation abnormalities.

**Dengue shock syndrome (DHF grades III and IV)** is the most severe form of the disease (approximately 25% of cases) and is characterized by severe hypovolemia and shock. Fatality rates range from 1% to 5%, although much higher rates have been reported. Complications include severe bleeding, pleural effusions, shock, pneumonia, liver dysfunction or failure, encephalopathy, and pulmonary hemorrhage.

The underlying immunopathology of severe dengue infection involves host and viral factors, and possibly sequential infections with different virus serotypes.
### TABLE 5. Degree of illness in dengue infection

<table>
<thead>
<tr>
<th>Mild/Moderate (Dengue fever)</th>
<th>Severe (DHF grades I and II)</th>
<th>Severe (Dengue shock syndrome, DHF grade III)</th>
<th>Very Severe (DHF grade IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental status: headache, malaise, irritable (can be soothed)</td>
<td>Mental status: headache, malaise, irritable (can be soothed)</td>
<td>Mental status: irritable (easily soothed), poor eye contact (lethargic), feeds poorly</td>
<td>Mental status: unresponsive, too weak to feed, extreme weakness, or seizures</td>
</tr>
<tr>
<td>No signs of dehydration</td>
<td>Signs of dehydration</td>
<td>Signs of moderate dehydration with hemoconcentration</td>
<td>Signs of severe dehydration with shock</td>
</tr>
<tr>
<td>Good peripheral perfusion</td>
<td>Good peripheral perfusion</td>
<td>Good peripheral perfusion</td>
<td>Poor peripheral perfusion</td>
</tr>
<tr>
<td>Normal blood pressure</td>
<td>Normal blood pressure</td>
<td>Pulse pressure &lt;20 mm Hg</td>
<td>Pulse pressure &lt;10 mm Hg, Capillary refill &gt;2 seconds</td>
</tr>
<tr>
<td>No signs of respiratory distress or pulmonary edema</td>
<td>No signs of respiratory distress or pulmonary edema</td>
<td>Signs of respiratory distress (pneumonia or pulmonary edema)</td>
<td>Signs of severe respiratory distress (pneumonia, pulmonary edema or CHF) with RR &gt;60</td>
</tr>
<tr>
<td>Tourniquet test: negative</td>
<td>Tourniquet test: positive Low platelet count &lt;100,000 Raised hematocrit &gt;20%</td>
<td>Tourniquet test: positive Low platelet count &lt;100,000 Raised hematocrit &gt;20% Signs of severe anemia or bleeding</td>
<td>Tourniquet test: positive; Low platelet count &lt;100,000; Raised hematocrit &gt;20%; Life threatening anemia, bleeding associated with DIC</td>
</tr>
<tr>
<td>No signs of metabolic or end-organ failure</td>
<td>No signs of metabolic or end-organ failure</td>
<td>No signs of metabolic or end-organ failure</td>
<td>Metabolic disorder, including hypoglycemia, metabolic acidosis, or liver or renal failure</td>
</tr>
</tbody>
</table>

DIC: Disseminated Intravascular Coagulation. DHF: Dengue Hemorrhagic Fever. RR: Respiratory Rate. CHF: Congestive Heart Failure.
infections with different virus serotypes. Cardinal features are a marked increase in capillary permeability and a bleeding disorder. Increased capillary permeability predisposes to pulmonary edema, pleural effusion, and ascites, as well as intravascular involvement and hemoconcentration. Bleeding (epistaxis, purpura, petechiae, gastrointestinal hemorrhage, menorrhagia) is related to disseminated intravascular coagulation (DIC), with thrombocytopenia and liver damage.

Leukopenia and neutropenia are characteristic findings. In dengue hemorrhagic fever and dengue shock syndrome, most common laboratory findings include hemoconcentration, thrombocytopenia, increased prothrombin time, and abnormalities in fibrinogen and other coagulation factors. Liver function may be impaired (in particular with elevated transaminases). Virus isolation and serologic tests confirm the diagnosis.

**Treatment of dengue**

For patients with grades III and IV DHF, administer an isotonic fluid (Ringer’s lactate or normal saline solution) at 10 to 20 mL/kg/hour for hemodynamic stabilization. To prevent fluid overload, reduce the rate of infusion to 1 to 5 mL/kg/hour as soon as the hemodynamic condition stabilizes. If there is no improvement (perfusion, pulse pressure, or hematocrit) within 1 hour, consider changing to a colloid solution.

Hospitalize grade IV DHF patients in an intensive care unit whenever possible. In these cases monitor fluid replacement. If pulse pressure on admission is <10 mm Hg, consider initial resuscitation with a colloid solution starting at 10 mL/kg/hour. Also consider transfusion with whole blood or packed red cells and fresh frozen plasma to correct severe anemia and to replace clotting factors. Heparin should be used with caution only when DIC persists despite hemodynamic stabilization, correction of acidosis, and good oxygenation. Systemic steroids do not appear to be effective. Diuretics may be required in the recovery phase to prevent sustained fluid overload.
OTHER CASES THAT REQUIRE ATTENTION AT THE SCENE OF THE DISASTER

OBJECTIVES

- Distinguish other clinical entities that can present at the scene of the disaster, such as tuberculosis.
- Consider meningitis in emergency settings and assess the clinical findings.

Meningitis

Meningitis is the inflammation of the membranes (meninges) that surround the brain and spinal cord. Encephalitis is the inflammation of the cerebral cortex. Meningoencephalitis involves both the meninges and the cerebral cortex.

Meningitis may be due to viral, bacterial, or fungal infections. Approximately two thirds of diagnosed cases are viral and one third are bacterial. The most common viral infections are caused by enteroviruses and herpes simplex virus.

The most common bacterial pathogens that cause meningitis during the first 3 months of life include group B Streptococcus (GBS), Escherichia coli, Listeria monocytogenes, enterococci, Staphylococcus aureus, and gram-negative enteric organisms. The viral pathogens in this age group are herpes simplex virus, enterovirus, and cytomegalovirus.

Pathogens infecting infants older than 3 months of age and children are most often S. pneumoniae, Haemophilus influenzae type b (Hib) and Neisseria meningitidis. Other organisms such as M. tuberculosis, Salmonella, and Mycoplasma pneumoniae are rare.

The frequency of Haemophilus infection has dramatically decreased with immuniza-

Tuberculosis

Even though tuberculosis (TB) is the leading infectious cause of death in some parts of the developing world, TB treatment and control programs are not part of an emergency relief response. TB is a chronic infection and effective treatment is very resource-intensive. Treatment programs need to include resources to identify and monitor true cases by sputum smears exam, a stable population for at least 6 months (to complete short-course therapy), enough available drugs to treat all cases, and enough personnel to supervise all therapy in the first 2 to 3 months. Administration of anti-TB drugs to persons who will not adhere to or complete treatment is likely to contribute to drug resistance in the community.

Even though tuberculosis (TB) is the leading infectious cause of death in some parts of the developing world, TB treatment and control programs are not part of an emergency relief response.
SECTION V / OTHER CASES THAT REQUIRE ATTENTION

Suspected cases of severe sepsis or meningitis need to be treated promptly with the best available drugs. Report such cases to health authorities and make attempts to obtain appropriate samples for identification of the causative agent.

Identification of *Neisseria meningitidis* is particularly important because of its epidemic potential and the fact that a reasonably effective vaccine is available. During confirmed *N. meningitidis* outbreaks, implement vaccination and chemoprophylaxis of household contacts. *N. meningitidis* remains susceptible to penicillin all over the world. A long-acting suspension of chloramphenicol in oil, called tifomycin, could be an alternative to penicillin. When other antibiotics are available, the initial antibiotic therapy depends on the age of the patient. Treat newborn infants with ampicillin and an aminoglycoside (gentamicin) or cefotaxime. Ampicillin is needed to cover *Listeria* and enterococci. Treat infants 1 to 3 months of age with ampicillin and ceftriaxone, or cefotaxime to cover enterococcus, *Listeria*, and *H. influenzae*. Treat older children with vancomycin and ceftriaxone if the rate of penicillin-resistant *S. pneumoniae* in the area is high.

When nonsusceptible organisms are identified, consider the recommended high doses of cefotaxime and ceftriaxone, and add rifampin when the minimum inhibitory concentration (MIC) of the nonsusceptible pneumococci is >2.0 µg/mL. If possible, obtain serum creatinine levels before giving vancomycin and repeat weekly during treatment, because vancomycin excretion depends on glomerular filtration.

Clinical findings of meningitis

Look for changes in mental status and level of activity, including irritability, changes in feeding and sleeping patterns, unresponsiveness, and seizures.

Check for signs of meningeal irritation: nuchal rigidity, bulging fontanelle, paradoxical irritability, and Brudzinski and Kernig signs.

Evaluate hydration status and signs of shock, such as mottled skin, slow capillary refill, increased pulse, and decreased blood pressure. Perform a neurologic examination and document focal neurologic signs, paresis, or ataxia. Measure the head circumference and look for exanthem, purpura or petechiae, or soft-tissue, bone, or joint infections.

Signs associated central nervous system complications include focal neurologic findings, prolonged seizures, persistent changes in mental status, enlarging head circumferences, or ataxia. Complications include subdural effusion or empyema, cerebral edema, cerebral abscess, cerebral infarction, or hydrocephalus.

Treatment of meningitis

Suspected cases of severe sepsis or meningitis need to be treated promptly with the best available drugs. Report such cases to health authorities and make attempts to obtain appropriate samples for identification of the causative agent.

Identification of *Neisseria meningitidis* is particularly important because of its epidemic potential and the fact that a reasonably effective vaccine is available. During confirmed *N. meningitidis* outbreaks, implement vaccination and chemoprophylaxis of household contacts. *N. meningitidis* remains susceptible to penicillin all over the world. A long-acting suspension of chloramphenicol in oil, called tifomycin, could be an alternative to penicillin. When other antibiotics are available, the initial antibiotic therapy depends on the age of the patient. Treat newborn infants with ampicillin and an aminoglycoside (gentamicin) or cefotaxime. Ampicillin is needed to cover *Listeria* and enterococci. Treat infants 1 to 3 months of age with ampicillin and ceftriaxone, or cefotaxime to cover enterococcus, *Listeria*, and *H. influenzae*. Treat older children with vancomycin and ceftriaxone if the rate of penicillin-resistant *S. pneumoniae* in the area is high.

When nonsusceptible organisms are identified, consider the recommended high doses of cefotaxime and ceftriaxone, and add rifampin when the minimum inhibitory concentration (MIC) of the nonsusceptible pneumococci is >2.0 µg/mL. If possible, obtain serum creatinine levels before giving vancomycin and repeat weekly during treatment, because vancomycin excretion depends on glomerular filtration.
Use penicillin G, ampicillin, cefotaxime, or ceftriaxone for *N. meningitidis*. The duration of intravenous therapy varies with the pathogen. Treat gram-negative enteric organisms for 21 days; *S. pneumoniae* for 10 to 14 days; *H. influenzae* for 7 to 10 days, and *N. meningitidis* for 4 to 7 days.

When using aminoglycosides or chloramphenicol, monitor blood levels if possible (therapeutic levels for gentamicin or tobramycin are 4 to 8 µg/mL; for kanamycin or amikacin, 15 to 25 µg/mL). Adequate blood chloramphenicol levels can be achieved with oral administration. Whenever possible, avoid administering aminoglycosides in patients with renal disease and chloramphenicol in patients with hepatic dysfunction.
VACCINATION IN DISASTER SITUATIONS

OBJECTIVES

- Acknowledge the importance of measles immunization in a disaster situation.
- Recognize the characteristics of tetanus-prone injuries and wounds.
- Describe specific situations that require the use of other vaccines.

The only vaccine that must be routinely administered during immediate emergency relief efforts is measles. A routine immunization program for other vaccines should only be considered if the population is expected to stay in the area for longer than 3 months, if it is possible to keep appropriate records, and if other assistance efforts are not disrupted or compromised by the activities needed for vaccination.

Tetanus

Tetanus immunization is not routinely recommended in disaster situations, but if the vaccine is available, it is reasonable to apply it prophylactically to individuals who have tetanus-prone wounds if the time of the last tetanus immunization is unknown or greater than 5 years, or when the child has not received the primary 3-dose vaccination series. The characteristics of tetanus-prone wounds are a wound that was first cleaned more than 6 hours after its occurrence; irregular wounds; wounds from bullets, crushing, burns, or frostbite; and presence of devitalized tissue or wound contaminants.

Specific situations requiring prophylaxis

Pertussis

The vaccine. It is well established that pertussis vaccine provides clinical protection after exposure to the disease in most people. The effectiveness of the vaccine with a regimen of 3 or more doses is around 80% to 90%. Appropriately immunized children who acquire the disease have milder symptoms and fewer complications.

Management of outbreaks. When an increase in the number of cases is suspected, mass immunization is a priority in children under 7 years old. If disease rates are higher among children over 7 years old and adolescents, use of acellular vaccines may be considered.

Household contacts—vaccination. Household contacts and other close contacts of patients under 7 years old who have had at least 4 previous doses of diphtheria-tetanus-pertussis vaccine (DTP or DTaP) must receive a booster injection of DTP or DTaP, unless they have received a dose within the past 3 years. Children under 7 years old who have not been immunized or who have previously received less than 4 doses must start or continue their vaccination.
SECTION VI / VACCINATION IN DISASTER SITUATIONS

regimen according to the national program. A fourth dose must be administered to children who received their third dose 6 or more months before exposure.

Chemoprophylaxis. All household contacts and other close contacts, regardless of their age or immune status, should receive erythromycin (40-50 mg/kg/day orally, divided in 4 doses), for 14 days because immunity after vaccination is not total and infection may not be prevented. It has been proven that erythromycin eliminates the carrier state and is effective in limiting secondary spread. For patients who are intolerant to erythromycin, clarithromycin (15 mg/kg/day orally divided in 2 doses, for 1 week) may be administered; other options are azithromycin and trimethoprim-sulfamethoxazole.

Diphtheria

The vaccine. In diphtheria, as in tetanus, immunity relies only on the presence in blood and interstitial fluids of antitoxin IgG antibodies with titers \( \geq 0.01 \) IU/mL. These antibodies work locally, where the toxin is released by the bacteria, and in blood against the toxin that reaches the circulation. After primary immunization with 3 doses of toxoid, antitoxin titers above 0.01 IU/mL can be found for 5 or more years, and after one or more booster injections they persist for 10 years. In clinical practice, vaccination has shown an efficacy rate above 99%.

Management of outbreaks. When cases of diphtheria are suspected, mass vaccination is indicated, taking into account the rates of incidence by age groups.

Household contacts—vaccination. Asymptomatic contacts whose immunization regimen is complete and who have received their last dose more than 5 years ago must receive a DTP or dT booster according to their age. Close asymptomatic contacts whose immunization regimen is incomplete (<3 doses of diphtheric toxoid) or whose immunization status is unknown must receive a dose and complete the schedule.

Chemoprophylaxis. Whatever their immunization status, close contacts must be kept under surveillance for 7 days to detect any evidence of the disease, have cultures taken for *Corynebacterium diphtheriae*, and receive antimicrobial prophylaxis with oral erythromycin (40-50 mg/kg/day for 7 days, with a maximum of 2 g/day) or a single intramuscular (IM) dose of penicillin G benzathine (600,000 IU for those <30 kg and 1.2 million units for older children and adults). Obtain new throat cultures in contacts identified as carriers within 2 weeks after completion of treatment.

Meningococcal disease

Few infectious diseases cause as much concern among the general population and health workers as meningococcal infection. The estimated attack rate for household contacts is 4 cases per 1,000 exposed persons. This is 500 to 800 times higher than rates in the general population.

Chemoprophylaxis is indicated for those individuals who meet the criteria for close contacts. The goal is to eradicate *N. meningitidis* carriers and prevent the occurrence of secondary cases.
• Close contacts: household members, attendees at child care centers, nursery schools, schools, universities, and members of closed communities that are in contact with any individual with meningococcal disease for more than 4 hours daily, 5 days a week; any other person directly exposed to oral secretions of the patient (e.g., sharing tableware, drinks, kisses; sneezing or coughing).

• Secondary case: any case occurring in a close contact 24 hours or more after onset of the disease in the primary case.

Because there is a high rate of secondary disease during the 5 days following contact, give chemoprophylaxis within the first 24 hours. It is not indicated beyond 14 days. A nasopharyngeal culture to determine the need for chemoprophylaxis is not warranted. If the patient was treated with third-generation cephalosporins, chemoprophylaxis before discharge is not needed. Rifampin is the first choice agent for chemoprophylaxis in children, but there are alternatives for adults (Table 4). Chemoprophylaxis is indicated for household members and contacts (Box 5). Monitor exposed individuals and assess if they have a febrile disease.

The vaccine: immunogenicity and effectiveness. With unconjugated polysaccharide vaccines, protection is achieved 7 to 10 days after immunization. Bivalent A + C vaccine is safe and effective (85% to 90%) in children older than 2 years old and in adults. The A component induces an immune response from 3 months of age on, with a seroconversion rate of 88% after the second dose, applied in children between 7 and 12 months old.

Management of outbreaks. An outbreak of meningococcal disease is defined when the attack rate is higher than 10 cases in 100,000 persons, in a specific area, with an epidemiologic relation among cases, and with a predominating serogroup. With active epidemiologic surveillance, an outbreak

<table>
<thead>
<tr>
<th>TABLE 4. Recommended agents for chemoprophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent</strong></td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Rifampin</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
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<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
</tr>
</tbody>
</table>

IM: Intramuscular.
is also considered when the incidence rate by age is doubled.

Where can outbreaks occur? Outbreaks can occur in an institution or an organization. In this case, an outbreak is defined by 3 or more confirmed, presumptive, or probable cases occurring in a period of 3 months or less within the same institution or organization, but without close contacts (e.g., schools, universities, military organizations, jails).

Community outbreaks are defined by 3 or more confirmed, presumptive, or probable cases that occur in 3 months or less among people who live in the same area and are not close contacts (e.g. small towns, cities, countries).

**Guidelines for evaluation and management of a meningococcal disease outbreak**

1. **Reinforcement of active surveillance**
   In areas where surveillance for meningococcal disease is passive, case reports may be incomplete or delayed. When an outbreak is suspected, alert public health authorities and request immediate report of new cases.

2. **Case detection and bacteriologic confirmation**
   Establish the diagnosis of meningococcal disease considering confirmed, presumptive, or probable cases.
   - **Confirmed case:** isolation of *N. meningitidis* from a usually sterile site (blood, CSF) in an individual with clinically consistent findings.
   - **Presumptive case:** observation of Gram-negative diplococci in any usually sterile site, with negative cultures and symptoms of disease.
   - **Probable case:** positive antigen test for *N. meningitidis* (latex agglutination test, immunoelectrophoresis), with negative cultures and consistent symptoms.

Information about serogroup is essential. Laboratories not performing this test routinely should forward the sample to referral

**BOX 6. Indications for chemoprophylaxis**

**Contacts who should receive chemoprophylaxis**
- Household members
- Individuals who often sleep or eat with the patient, and meet the definition of contact
- Contacts in child care centers and nursery schools (including staff members) for more than 4 hours during 5 days of the previous week
- Individuals who have been directly exposed to the patient’s secretions through kissing or sharing food, drinks, toothbrushes, etc.
- Individuals administering mouth-to-mouth resuscitation
- Individuals who experience unprotected contact during endotracheal intubation in the 7 days prior to the onset of the disease

**Situations where chemoprophylaxis is NOT indicated:**
- Casual contact: no direct exposure to the patient’s oral secretions (classmates or coworkers)
- Indirect contact: no contact with the patient, only with his/her contact
- Health care workers with no direct exposure to the patient’s oral secretions
laboratories of higher complexity to identify the serogroup. If possible, investigate *N. meningitidis* subtype by pulsed-field gel electrophoresis or multilocus enzyme electrophoresis to determine if the strains of a group of cases are interrelated and whether they represent an outbreak.

3. Appropriate treatment of patients, according to management guidelines

4. Chemoprophylaxis and careful observation of contacts
Chemoprophylaxis and careful observation are recommended for close contacts. Chemoprophylaxis for individuals who are not close contacts is ineffective in preventing community outbreaks; therefore, it is not recommended. Exposed individuals must be carefully monitored and evaluated in case of any febrile illness.

5. Investigation of relationships between cases
In addition to demographics, obtain the following information for each affected individual: history of close contact with another primary case; participation in social activities or sports; attendance at child care centers, kindergartens, schools, universities, or clubs. This information will help identify cases as co-primary or secondary, reveal relationships between cases, and define the population at risk.

6. Assessment of the relationship of the suspected outbreak with the community or with an institution or organization

7. Definition of at-risk population
In outbreaks related to an institution or organization, cases are linked with a shared affiliation, such as attending the same day care center, kindergarten, school, or university or belonging to the same sports team. In such cases, the population at risk is everyone in those places. On the other hand, in community outbreaks patients do not share an affiliation, only a geographically defined location, such as a neighborhood, small town, city, or country. The risk group includes every individual living in those places.

8. Estimation of attack rate
Attack rate can be estimated by the following formula:

\[
\text{Attack rate} = \frac{\text{Number of probable and confirmed cases (over a 3-month period)}}{\text{Population at risk}} \times 100,000
\]
With a global attack rate higher than 10 cases in 100,000, consider vaccination of at-risk population. Consider the incidence rates by age groups. If the incidence rate doubles in a population with adequate epidemiological surveillance, immunization may be considered.

9. Selection of the target group for vaccination
Consider the guidelines from public health authorities regarding the serogroup involved and the age group affected. In that case, it is necessary to have adequate vaccine supplies.
OBJECTIVE

- Identify and establish the treatment for sick infants 0 to 2 months of age.

Assessment of the sick infant 0 to 2 months of age

As mentioned previously, newborn and infants under 2 months of age are very vulnerable to infections, with high morbidity and mortality rates associated with very severe clinical conditions including sepsis, meningitis, and pneumonia. Thus, if an infant under 2 months is suspected of having a severe neonatal illness or a possible severe bacterial infection, there is no time to lose in laboratory studies. It is extremely important to start antibiotic therapy immediately and to refer the patient to a hospital if needed resources are not available.

Infants weighing less than 2,000 g who are brought to the primary health care facility with a possible infection should be referred to a hospital for specialized treatment, regardless of the severity of the condition, because they are more vulnerable due to their immaturity.

The assessment of the infant 0 to 2 months old should include the following questions:

- What is your baby doing?
- Is he/she feeding well or poorly?
- Has he/she vomited / Is he vomiting all he eats?
- Has he/she had diarrhea?
- Has he/she difficulty breathing?
- Has he/she had fever or hypothermia?
- Has he/she had seizures or shivering?

In addition, look for clinical signs that indicate the severity of the illness, from subtle signs such as “he doesn’t look good” to neurologic signs (e.g., seizures) or difficult breathing. Assessment of body temperature, hydration status, capillary refill, and fontanelle characteristics are also important, as well as looking for other problems (congenital anomalies, surgical disorders). Figure 3 shows the algorithm used by the Integrated Management of Chilhood Illness (IMCI) for assessment of sick infants 0 to 2 months of age.

Classification of the infant 0 to 2 months of age with severe illness or possible severe bacterial infection

Based on general danger signs, infants can be classified into four different categories as shown in Table 5.

Children presenting with any sign in the upper row of Table 5 are classified as having a severe illness or possible severe...
**bacterial infection.** In infants younger than 2 months old, it is difficult to distinguish between a very severe illness and a severe infection, such as sepsis or meningitis, since clinical findings are usually similar. For this reason, the classification gives both possibilities.

If the infant is suffering from a local but extensive bacterial infection, he or she should also be classified as having a possible severe bacterial infection because the local infection can disseminate and result in sepsis, due to the immaturity of the immune system. He or she needs to be referred urgently to a specialized hospital to receive different kinds of treatments, such as oxygen or parenteral antibiotics. Before transfer, administer the first dose of the adequate antibiotic. Transfer according to the guidelines for stabilization and transport. Counsel the mother or caregiver in order to clarify possible doubts and provide support.

Infants with no general danger signs but who have purulent discharge from the umbilicus or eyes, pustules in the skin (limited in number or localized), are classified as having a local bacterial infection. Children who exhibit no danger signs are classified as having no bacterial infection.

**Treatment of infants 0 to 2 months of age with infection**

Infants 0 to 2 months old who need to be transferred to a hospital more than 5 hours away should receive an intramuscular (IM) dose of an adequate antibiotic. Possible antibiotic combinations include:
- gentamicin + ampicillin
- gentamicin + G penicillin procaine
Avoid oral feeding if the infant presents with altered consciousness or difficult breathing, and administer a 5% dextrose solution through nasogastric tube to prevent hypoglycemia.

If there is no incubator available for the transfer, the “mother kangaroo” technique is advisable in order to prevent hypothermia. If available, also administer supplemental oxygen during the transfer to prevent hypoxemia.

Infants 0 to 2 months of age with a local bacterial infection should receive an adequate oral antibiotic as well as topical antibiotic therapy according to the site of infection.
### TABLE 5. Classification of the infant 0 to 2 months with severe illness or possible severe bacterial infection

<table>
<thead>
<tr>
<th>SIGNS</th>
<th>CLASSIFY AS</th>
<th>TREATMENT</th>
</tr>
</thead>
</table>
| **(RED)** One out of the following signs:  
- “Doesn’t look good”  
- Cannot be breastfed  
- Lethargic/unconscious or flaccid  
- Vomiting  
- Seizures  
- Intense pallor  
- Weight <2,000 g  
- RR > 60 or <30 per min  
- Temperature <36.5ºC or >37.5ºC  
- Bulging fontanelle  
- Apnea  
- Nasal flaring  
- Grunting  
- Severe lower chest wall indrawing  
- Central jaundice  
- Jaundice below the umbilicus  
- Petechiae, pustules or vesicles in the skin (many or extended)  
- Pus drainage from ear  
- Umbilicus redness extending to skin  
- Poor capillary refill (>2 sec)  
- Abdominal distension | **(RED)** SEVERE ILLNESS OR POSSIBLE SEVERE BACTERIAL INFECTION | **(RED)**  
- URGENTLY refer to hospital, according to the guidelines for stabilization and transportation  
- Give the first IM dose of recommended antibiotics  
- Prevent hypoglycemia  
- Keep the child warm  
- Advise the mother/caregiver not to stop breastfeeding  
- Clarify any doubt and give support to the mother/caregiver  
- Advise mother to accompany the child and show how to keep the infant warm on the way to the hospital |
| **(YELLOW)**  
- Ocular pus discharge  
- Red umbilicus or draining pus  
- Skin pustules (few or localized) | **(YELLOW)** LOCAL BACTERIAL INFECTION | **(YELLOW)**  
- Give an appropriate oral antibiotic for 7 days  
- Teach the mother/caregiver how to treat local infections at home  
- Apply local treatment (topical antibiotic)  
- Teach the mother/caregiver to recognize signs of danger  
- Clarify doubts and give support to the mother/caregiver  
- Follow up 2 days later |
| **(GREEN)**  
- Normal activity  
- Feeding well  
- Normal physical examination results  
- White plaques in the mouth | **(GREEN)** NO BACTERIAL INFECTION | **(GREEN)**  
- Counsel the mother to continue breastfeeding  
- No additional treatment  
- Teach the mother to recognize signs of danger and to implement hygienic measures  
- Tell the mother when to come back to the clinic  
- Check immunization status  
- Clarify doubts and give support to the mother/caregiver  
- Consider applying Nistatin locally 100,000 units in the mouth, 4 times a day |
**SUMMARY**

The morbidity and mortality associated with infectious diseases are very high in developing countries. During acute humanitarian emergencies, morbidity and mortality increase significantly. Deterioration of the nutritional status associated with such situations increases the risk of infectious diseases among the affected children.

The IMCI strategy, designed for primary care management of children and based on a number of clinical signs at presentation, is an ideal tool for the effective management of people affected by disasters, particularly in situations with limited resources, both material and human. This tool allows a quick and simple distinction between children who require referral to the hospital and those with less severe illness that can be managed in a less complex setting.

Measles, acute respiratory infections, malaria, dengue, and acute diarrhea are the infections that cause more concern in an emergency setting. Take also into consideration sepsis and meningitis. It is important to recognize these diseases as early as possible in order to give appropriate therapy and prevent a possible outbreak among people displaced by a disaster.

**SUGGESTED READING**


Cases resolution

Case 1
The child is ill-appearing, febrile, tachycardic, and tachypneic with physical examination findings remarkable for scattered petechiae on the abdomen and lower extremities. The primary concern is whether this child is in shock. Tachycardia and decreased capillary refill are consistent with compensated shock.

Since the child is febrile and has a history of an upper respiratory disease, the most likely etiology of the shock is sepsis. The fever and the presence of petechiae suggest a severe bacterial infection, most likely meningococcemia. While many other conditions such as viral infection—influenza, enterovirus, adenovirus, infectious mononucleosis, or group A Streptococcus infection—can present with fever and petechiae, meningococcal infection is rapidly progressive and life-threatening.

Initial management begins with 100% oxygen. An IV line is placed and a blood sample is sent for complete blood count, serum electrolytes, coagulation studies, and culture. Rapid blood glucose determination is 120 mg/dL. As the child is tachypneic and has signs of shock, the lumbar puncture is deferred and IV antibiotics are administered immediately. An IV bolus of normal saline is given because of poor oral intake and decreased urine output, with no signs of cardiac or pulmonary disease.

His initial laboratory tests show a white blood cell count of 21,000. Serum bicarbonate is 11, prothrombin time 15 seconds, and partial thromboplastin time 28 seconds.

Over the next several hours the child develops purpura, had increasing respiratory distress, and labile blood pressure. He is intubated and ventilated. His blood culture reveals N. meningitidis.

Case 2
The infant is manifesting many of the classic features of an acute presentation of bacterial meningitis. The patient is irritable, febrile, and has a bulging fontanelle. The fact that the patient has a supple neck should not dissuade the examiner from the overall impression of meningitis. Children younger than 18 months frequently lack sufficient neck musculature to manifest nuchal rigidity.

Because the patient is well-oxygenated and has stable vital signs, the most pressing intervention is the rapid delivery of IV antibiotics. Antibiotics should cover all possible organisms, especially S. pneumoniae. Treatment should begin with cefotaxime or ceftriaxone and vancomycin (if resistant S. pneumoniae is in the community). Possible complications of meningitis include seizures, syndrome of inappropriate antidiuretic hormone (SIADH), and intracranial hypertension.

(Adapted from ACEP/AAP. The APLS: The Pediatric Emergency Medicine Resource. 4th ed, 2004.)
MODULE REVIEW

SECTION I- INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS (IMCI)
1. What is IMCI?
2. What are the IMCI steps for the assessment of sick children?
3. What are the general danger signs that must be routinely checked in all children?

SECTION II- MEASLES
1. How should measles immunization be implemented?
2. What is the relationship between vitamin A and measles?
3. How is a measles diagnosis made?
4. Which are the most common complications of measles?

SECTION III- ACUTE RESPIRATORY INFECTIONS
1. What are the clinical signs that should be assessed in children with cough or respiratory problems?
2. What are the antibiotics used for lower respiratory infections?
3. How should ear problems be assessed?

SECTION IV- FEBRILE ILLNESSES: MALARIA, DENGUE
1. How is a malaria diagnosis made?
2. What is the clinical presentation of malaria?
3. What is the treatment for classic malaria and for complicated malaria?
4. How is dengue infection classified?

SECTION V: OTHER CASES THAT REQUIRE ATTENTION AT THE SCENE OF THE DISASTER
1. What clinical signs raise the suspicion of meningitis?
2. What must be taken into consideration for the treatment of meningitis?
SECTION VI - VACCINATION IN DISASTER SITUATIONS

1. What interventions are recommended when tetanus is suspected?
2. What are the situations that require prophylaxis?
3. How should a meningitis outbreak be evaluated and managed?

SECTION VII - INFECTIONS IN INFANTS 0 TO 2 MONTHS OF AGE

1. What are the clinical signs that suggest a severe illness in infants 0 to 2 months of age?
2. What immediate action should be taken with an infant 0 to 2 months of age with severe illness?
### Guidelines for Treatment of Malaria in the United States

**Guidelines for Treatment of Malaria in the United States**

(Based on drugs currently available for use in the United States)

**CDC Malaria Hotline:** (770) 488-7788 Monday-Friday 8 am to 4:30 pm EST (770) 488-7100 after hours, weekends and holidays (ask to page the malaria person on-call)

### Clinical Diagnosis/Plasmodium species

<table>
<thead>
<tr>
<th>Region Infection Acquired</th>
<th>Recommended Drug and Adult Dose</th>
<th>Recommended Drug and Pediatric Dose</th>
</tr>
</thead>
</table>
| Uncomplicated malaria/ *P. falciparum* or Species not identified If “species not identified” is subsequently diagnosed as *P. vivax* or *P. ovale* (below) re-treatment with primaquine | A. Atovaquone-proguanil (Malarone™)2  
Adult tab = 250 mg atovaquone/100 mg proguanil  
4 adult tabs po qd x 3 days | A. Atovaquone-proguanil (Malarone™)2  
Adult tab = 250 mg atovaquone/100 mg proguanil  
Peds tab = 62.5 mg atovaquone/25 mg proguanil  
5 - 8 kg: 2 peds tabs po qd x 3 d  
9-10 kg: 3 peds tabs po qd x 3 d  
11-20 kg: 1 adult tab po qd x 3 d  
21-30 kg: 2 adult tabs po qd x 3 d  
31-40 kg: 3 adult tabs po qd x 3 d  
> 40 kg: 4 adult tabs po qd x 3 d |
| Chloroquine-resistant or unknown resistance1 (All malarious regions except those specified as chloroquine-sensitive listed in the box below. Middle Eastern countries with chloroquine-resistant *P. falciparum* include Iran, Oman, Saudi Arabia, and Yemen. Of note, infections acquired in the Newly Independent States of the former Soviet Union and Korea to date have been uniformly caused by *P. vivax* and should therefore be treated as chloroquine-sensitive infections.) | B. Artemether-lumefantrine (Coartem™):  
1 tablet = 20 mg artemether and 120 mg lumefantrine  
A 3-day treatment schedule with a total of 6 oral doses is recommended for both adult and pediatric patients based on weight. The patient should receive the initial dose, followed by the second dose 8 hours later; then I dose po bid for the following 2 days.  
5 - <15 kg: 1 tablet per dose  
15 - <25 kg: 2 tablets per dose  
25 - ≤35 kg: 3 tablets per dose  
≥35 kg: 4 tablets per dose | C. Quinine sulfate3 plus one of the following: Doxycycline5, Tetracycline5 or Clindamycin  
Quinine sulfate: 8.3 mg base/kg (=10 mg salt/kg) po tid x 3 or 7 days5  
Doxycycline: 2.2 mg/kg po every 12 hours x 7 days  
Tetracycline: 25 mg/kg/day po divided qid x 7 days  
Clindamycin: 20 mg base/kg/day po divided tid x 7 days |
| Chloroquine-sensitive (Central America west of Panama Canal; Haiti; the Dominican Republic; and most of the Middle East) | C. Quinine sulfate1 plus one of the following: Doxycycline1, Tetracycline1 or Clindamycin  
Quinine sulfate: 8.3 mg base/kg (=10 mg salt/kg) po tid x 3 or 7 days1  
Doxycycline: 2.2 mg/kg po every 12 hours x 7 days  
Tetracycline: 25 mg/kg/day po divided qid x 7 days  
Clindamycin: 20 mg base/kg/day po divided tid x 7 days | D. Mefloquine (Lariam™ and generics):  
13.7 mg base/kg (= 15 mg salt/kg) po as initial dose, followed by 9.1 mg base/kg (= 10 mg salt/kg) po given 6-12 hours after initial dose  
Total dose = 25 mg salt/kg |

Chloroquine phosphate (Aralen™ and generics)  
600 mg base (= 1,000 mg salt) po immediately, followed by 300 mg base (= 500 mg salt) po at 6, 24, and 48 hours  
Total dose: 1,500 mg base (= 2,500 mg salt) OR  
Hydroxychloroquine (Plaquenil™ and generics)  
10 mg base/kg po immediately, followed by 5 mg base/kg po at 6, 24, and 48 hours  
Total dose: 25 mg base/kg OR  
Hydroxychloroquine (Plaquenil™ and generics)  
10 mg base/kg po immediately, followed by 5 mg base/kg po at 6, 24, and 48 hours  
Total dose: 25 mg base/kg
### Uncomplicated malaria

#### P. malariae or P. knowlesi
- All regions
- Recommended Drug and Adult Dose: Chloroquine phosphate: Treatment as above OR Hydroxychloroquine: Treatment as above
- Recommended Drug and Pediatric Dose: Chloroquine phosphate: Treatment as above OR Hydroxychloroquine: Treatment as above

#### P. vivax or P. ovale
- All regions
- Recommended Drug and Adult Dose: Chloroquine phosphate plus Primaquine phosphate
  - Chloroquine phosphate: Treatment as above
  - Primaquine phosphate: 30 mg base po qd x 14 days OR Hydroxychloroquine plus Primaquine phosphate: Treatment as above
- Recommended Drug and Pediatric Dose: Chloroquine phosphate plus Primaquine phosphate
  - Chloroquine phosphate: Treatment as above
  - Primaquine phosphate: 0.5 mg base/kg po qd x 14 days OR Hydroxychloroquine plus Primaquine phosphate: Treatment as above

### Chloroquine-resistant P. vivax
- (Papua New Guinea and Indonesia)
- Recommended Drug and Adult Dose: A. Quinine sulfate plus either Doxycycline or Tetracycline plus Primaquine phosphate
  - Quinine sulfate: Treatment as above
  - Doxycycline or Tetracycline: Treatment as above
  - Primaquine phosphate: Treatment as above
- B. Atovaquone-proguanil plus Primaquine phosphate
  - Atovaquone-proguanil: Treatment as above
  - Primaquine phosphate: Treatment as above
- C. Mefloquine plus Primaquine phosphate
  - Mefloquine: Treatment as above
  - Primaquine phosphate: Treatment as above

### Chloroquine-sensitive
- (see uncomplicated malaria sections above for chloroquine-sensitive Plasmodium species by region)
- Recommended Drug and Adult Dose: Chloroquine phosphate: Treatment as above OR Hydroxychloroquine: Treatment as above

### Chloroquine-resistant P. falciparum
- (see sections above for regions with chloroquine resistant P. falciparum)
- Recommended Drug and Adult Dose: Quinine sulfate plus Clindamycin
  - Quinine sulfate: Treatment as above
  - Clindamycin: Treatment as above

### Chloroquine-resistant P. vivax
- (see uncomplicated malaria sections above for regions with chloroquine-resistant P. vivax)
- Recommended Drug and Adult Dose: Quinine sulfate
  - Quinine sulfate: 650 mg³ salt po tid x 7 days

---

**Note:** For suspected chloroquine-resistant P. vivax, see row below.
**APPENDIX**

<table>
<thead>
<tr>
<th>Clinical Diagnosis/ Plasmodium species</th>
<th>Region/Infection Acquired</th>
<th>Recommended Drug and Adult Dose</th>
<th>Recommended Drug and Pediatric Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe malaria13,14,15,16</td>
<td>All regions</td>
<td>Quinidine gluconate4 plus one of the following: Doxycycline, Tetracycline, or Clindamycin</td>
<td>Quinidine gluconate4 plus one of the following: Doxycycline4, Tetracycline4, or Clindamycin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quinidine gluconate: 6.25 mg base/kg (=10 mg salt/kg) loading dose IV over 1-2 hrs, then 0.0125 mg base/kg/min (= 0.02 mg salt/kg/min) continuous infusion for at least 24 hours. An alternative regimen is 15 mg base/kg (=24 mg salt/kg) loading dose IV infused over 4 hours, followed by 7.5 mg base/kg (= 12 mg salt/kg) infused over 4 hours every 8 hours, starting 8 hours after the loading dose (see package insert). Once parasite density &lt;1% and patient can take oral medication, complete treatment with oral quinine, dose as above. Quinidine/quinine course = 7 days in Southeast Asia; = 3 days in Africa or South America.</td>
<td>Quinidine gluconate: Same mg/kg dosing and recommendations as for adults. Doxycycline: Treatment as above. If patient not able to take oral medication, may give IV. For children &lt;45 kg, give 2.2 mg/kg IV every 12 hours and then switch to oral doxycycline (dose as above) as soon as patient can take oral medication. For children ≥45 kg, use same dosing as for adults. For IV use, avoid rapid administration. Treatment course = 7 days.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doxycycline: Treatment as above. If patient not able to take oral medication, give 100 mg IV every 12 hours and then switch to oral doxycycline (as above) as soon as patient can take oral medication. For IV use, avoid rapid administration. Treatment course = 7 days.</td>
<td>Doxycycline: Treatment as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tetracycline: Treatment as above.</td>
<td>Tetracycline: Treatment as above.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clindamycin: Treatment as above. If patient not able to take oral medication, give 10 mg base/kg loading dose IV followed by 5 mg base/kg IV every 8 hours. Switch to oral clindamycin (oral dose as above) as soon as patient can take oral medication. For IV use, avoid rapid administration. Treatment course = 7 days.</td>
<td>Clindamycin: Treatment as above. If patient not able to take oral medication, give 10 mg base/kg loading dose IV every 8 hours. Switch to oral clindamycin (oral dose as above) as soon as patient can take oral medication. For IV use, avoid rapid administration. Treatment course = 7 days.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Investigational new drugs (contact CDC for information): Artesunate followed by one of the following: Atovaquone-proguanil (Malarone™), Doxycycline (Clindamycin in pregnant women), or Mefloquine</td>
<td>Investigational new drugs (contact CDC for information): Artesunate followed by one of the following: Atovaquone-proguanil (Malarone™), Doxycycline (Clindamycin in pregnant women), or Mefloquine</td>
</tr>
</tbody>
</table>
Notes

1. There are 4 options (A, B, C or D) available for treatment of uncomplicated malaria caused by chloroquine-resistant *P. falciparum*. Options A, B and C are equally recommended. Because of a higher rate of severe neuropsychiatric reactions seen at treatment doses, we do not recommend option D (mefloquine) unless the other options cannot be used. For option C, because there is more data on the efficacy of quinine in combination with doxycycline or tetracycline, these treatment combinations are generally preferred to quinine in combination with clindamycin.

2. Take with food or whole milk. If patient vomits within 30 minutes of taking a dose, then they should repeat the dose.

3. US manufactured quinine sulfate capsule is in a 324 mg dosage; therefore, 2 capsules should be sufficient for adult dosing. Pediatric dosing may difficult due to unavailability of non-capsule forms of quinine.

4. For infections acquired in Southeast Asia, quinine treatment should continue for 7 days. For infections acquired elsewhere, quinine treatment should continue for 3 days.

5. Doxycycline and tetracycline are not indicated for use in children less than 8 years old. For children less than 8 years old with chloroquine-resistant *P. falciparum*, atovaquone-proguanil and artemether-lumefantrine are recommended treatment options; mefloquine can be considered if no other options are available. For children less than 8 years old with chloroquine-resistant *P. vivax*, mefloquine is the recommended treatment. If it is not available or is not being tolerated and if the treatment benefits outweigh the risks, atovaquone-proguanil or artemether-lumefantrine should be used instead.

6. Treatment with mefloquine is not recommended in persons who have acquired infections from Southeast Asian due to drug resistance.

7. Primaquine is used to eradicate any hypnozoites that may remain dormant in the liver, and thus prevent relapses, in *P. vivax* and *P. ovale* infections. Because primaquine can cause hemolytic anemia in G6PD-deficient persons, G6PD screening must occur prior to starting treatment with primaquine. For persons with borderline G6PD deficiency or as an alternate to the above regimen, primaquine may be given 45 mg orally one time per week for 8 weeks; consultation with an expert in infectious disease and/or tropical medicine is advised if this alternative regimen is considered in G6PD-deficient persons.

8. There are three options (A, B or C) available for treatment of uncomplicated malaria caused by chloroquine-resistant *P. vivax*. High treatment failure rates due to chloroquine-resistant *P. vivax* have been well documented in Papua New Guinea and Indonesia. Rare case reports of chloroquine-resistant *P. vivax* have also been documented in Burma (Myanmar), India, and Central and South America. Persons acquiring *P. vivax* infections outside of Papua New Guinea or Indonesia should be started on chloroquine. If the patient does not respond, the treatment should be changed to a chloroquine-resistant *P. vivax* regimen and CDC should be notified (Malaria Hotline number listed above). For treatment of chloroquine-resistant *P. vivax* infections, options A and B are equally recommended.

9. For pregnant women diagnosed with uncomplicated malaria caused by chloroquine-resistant *P. falciparum* or chloroquine-resistant *P. vivax* infection, treatment with doxycycline or tetracycline is generally not indicated. However, doxycycline or tetracycline may be used in combination with quinine (as recommended for non-pregnant adults) if other treatment options are not available or are not being tolerated, and the benefit is judged to outweigh the risks.

10. Atovaquone-proguanil and artemether-lumefantrine are generally not recommended for use in pregnant women. For pregnant women diagnosed with uncomplicated malaria caused by chloroquine-resistant *P. falciparum* infection, atovaquone-proguanil and artemether-lumefantrine may be used if other treatment options are not available or are not being tolerated, and if the potential benefit is judged to outweigh the potential risks.

11. Because of the possible association with mefloquine treatment during pregnancy and an increase in stillbirths, mefloquine is generally not recommended for treatment in pregnant women. However, mefloquine may be used if it is the only treatment option available and if the potential benefit is judged to outweigh the potential risks.

12. For *P. vivax* and *P. ovale* infections, primaquine phosphate for radical treatment of hypnozoites should not be given during pregnancy. Pregnant patients with *P. vivax* and *P. ovale* infections should be maintained on chloroquine prophylaxis for the duration of their pregnancy. The chemoprophylactic dose of chloroquine phosphate is 300 mg base (= 500 mg salt) orally once per week. After delivery, pregnant patients who do not have G6PD deficiency should be treated with primaquine.

13. Persons with a positive blood smear OR history of recent possible exposure and no other recognized pathology who have one or more of the following clinical criteria (impaired consciousness/coma, severe normocytic anemia, renal failure, pulmonary edema, acute respiratory distress syndrome, circulatory shock, disseminated intravascular coagulation, spontaneous bleeding, acidosis, hemoglobinuria, jaundice, repeated generalized convulsions, and/or parasitemia of > 5%) are considered to have manifestations of more severe disease. Severe malaria is most often caused by *P. falciparum*.

14. Patients diagnosed with severe malaria should be treated aggressively with parenteral antimalarial therapy. Treatment with IV quinidine should be initiated as soon as possible after the diagnosis has been made. Patients with severe malaria should be given an intravenous loading dose of quinidine unless they have received more than 40 mg/kg of quinidine in the preceding 48 hours or if they have received mefloquine within the preceding 12 hours. Consultation with a cardiologist and a physician with experience treating malaria is advised when treating malaria patients with quinidine. During administration of quinidine, blood pressure monitoring (for hypotension) and cardiac monitoring (for widening of the QRS complex and/or lengthening of the QTc interval) should be monitored continuously and blood glucose (for hypoglycemia) should be monitored periodically. Cardiac complications, if severe, may warrant temporary discontinuation of the drug or slowing of the intravenous infusion.

15. Consider exchange transfusion if the parasite density (i.e. parasitemia) is >10% OR if the patient has altered mental status, non-volume overload pulmonary edema, or renal complications. The parasite density can then be estimated by examining a monolayer of red blood cells (RBCs) on the thin smear under oil immersion magnification. The slide should be examined where the RBCs are more or less touching (approximately 400 RBCs per field). The parasite density is calculated from the percentage of infected RBCs and should be monitored every 12 hours. Exchange transfusion should be continued until the parasite density is <1% (usually requires 8-10 units). IV quinidine administration should not be delayed for an exchange transfusion and can be given concurrently throughout the exchange transfusion.

16. Pregnant women diagnosed with severe malaria should be treated aggressively with parenteral antimalarial therapy.
Module 6

Diarrhea and Dehydration

Clifton Yu | Douglas A. Lougee | Jorge R. Murno
INTRODUCTION

Poor sanitary conditions in disaster-stricken areas result in higher risk for diarrheal illness in vulnerable populations, especially children. This disease negatively impacts the nutritional status of affected children and causes significant morbidity and mortality. Early diagnosis and treatment are thus essential to reduce the impact of diarrheal diseases on people affected by disasters. Early identification of cases allows the implementation of measures needed to prevent or lessen outbreaks that can occur in displaced populations in this context. The use of primary care management tools, such as the Integrated Management of Childhood Illness (IMCI) strategy is highly important.

This module will first discuss diarrheal diseases and their management, and then dehydration and its treatments.
Definition of diarrhea
Diarrhea is the passage of loose or watery stools at least 3 times in a 24-hour period. However, it is the consistency of the stools rather than the number that is most important. Acute diarrhea may be caused by different viruses, bacteria, and parasites. Rotavirus and Norwalk-like virus are the most common agents, causing up to 50% of acute diarrhea cases during the high-incidence seasons. It is most practical to base the treatment of diarrhea on the clinical type of the illness, which is easy to establish when a child is first examined. Usually there is no need for laboratory tests.

CASE
You are at the pediatric clinic set up in the social club of a neighborhood affected by a mudslide. An 11-month-old child is brought in by his mother. He has a history of 4 to 5 loose stools in the past 24 hours. She reports that initially the child vomited and had fever of 100°F (38°C), but now he tolerates oral fluids and is being breastfed, and he is still afebrile. There is no evidence of dehydration and he looks fairly well. The mother has not seen blood in the stools.

1 What is the most probable etiology of this infant’s illness?
2 What treatment should be given?
3 What measures should be taken to prevent recurrences?

Continues on page 200.
In disaster situations, due to over-crowded living conditions, lack of adequate clean water supply, and stool disposal, diarrhea is one of the most significant causes of morbidity and mortality, particularly among children. Early detection and treatment are therefore key elements in public health interventions, not only to manage individual cases but also to prevent transmission of the disease to the rest of the population. Effective hygiene measures markedly reduce the frequency of diarrheal diseases.

**Types of diarrhea**

In a disaster scenario a child with diarrhea may present with three potentially severe or very severe clinical conditions: (1) acute watery diarrhea (including cholera), which lasts several hours or days, and can cause dehydration, (2) acute bloody diarrhea or dysentery, which may cause intestinal damage, sepsis, malnutrition and dehydration, and (3) persistent diarrhea (diarrhea that lasts more than 14 days).

All children with diarrhea should be assessed to determine the duration of diarrhea, if there is blood in the stools, and if dehydration is present.

Acute watery diarrhea is mainly caused by rotavirus, Norwalk-like virus, entero-toxigenic *Escherichia coli* (ETEC), *Vibrio cholerae*, *Staphylococcus aureus*, *Clostridium difficile*, *Giardia*, and cryptosporidia. Most frequent pathogens associated with acute bloody diarrhea are *Shigella* and *Entamoeba histolytica*. *Campylobacter* sp, invasive *Escherichia coli*, *Salmonella*, *Aeromonas* organisms, *C. difficile*, and *Yersinia* sp can also cause bloody diarrhea.

**Management of acute watery diarrhea**

Dehydration is the most common complication of acute watery diarrhea in children. Assessment and treatment of this complication are discussed in Section III.

Watery diarrhea caused by organisms other than *Vibrio cholerae* is usually self-limited and requires no antibiotic therapy. It is important to note that antibiotics have the potential to prolong the disruption of intestinal homeostasis and delay the recovery of normal bowel flora. Therefore, the Integrated Management of Childhood Illness (IMCI) recommends use of oral antimicrobials only for children with bloody diarrhea (amoebic or bacterial dysentery), cholera, and giardiasis. Treatment for these infections is discussed later in this section.

Antidiarrheal or antiemetic medications are not recommended to treat acute diarrhea, since they reduce intestinal motility, lengthen the course of the disease, prolong the contact of the causal pathogen with the intestinal mucosa, and can worsen systemic symptoms.

Nutrition is also an important issue in children with diarrhea. It is widely recognized that fasting does not modify the outcome or severity of the diarrheal disease. Therefore, in a child with diarrhea and normal hydration status breastfeeding (or bottle feeding with usual milk or formula if the infant is not breastfed), as well as feeding with age appropriate food should be continued. A lactose-reduced or lactose-free diet provides no benefit to children with acute diarrhea.
In children with dehydration, feeding should be resumed as soon as normal hydration is achieved through any rehydration therapy appropriate for the severity of the dehydration. Remember that malnourished children are at higher risk of diarrhea due to intestinal mucosa alteration. The diarrheal illness in these patients can last longer because of the reduced enterocyte turnover. Thus, reduced food intake only worsens the degree of malnutrition prior to the episode of acute diarrhea.

Patients with diarrhea but no signs of dehydration usually have a fluid deficit less than 5% of their body weight. Although these children lack distinct signs of dehydration, they should be given more fluid than usual to prevent dehydration from developing. Table 1 shows the classification of diarrhea without dehydration or blood in stools, according to the IMCI strategy.

**Management of acute bloody diarrhea**

**Bacterial dysentery**

A child is classified as having dysentery if the mother or caregiver reports blood in the child’s stools. Bloody diarrhea in young children is usually a sign of invasive enteric infection that carries a substantial risk of serious morbidity and death. About 10% of all diarrhea episodes in children under 5 years old are dysenteric, but these cause up to 15% of all diarrheal deaths. Dysentery is especially severe in infants and children who are undernourished or who develop clinically-evident dehydration during their illness. Diarrheal episodes that begin with dysentery are more likely to become persistent than those that start without blood in the stools.

The goal of dysentery treatment is clinical improvement, as well as shortening the fecal shedding of the causative pathogen to limit transmission. Evaluate children with acute bloody diarrhea. Administer appropriate fluids to prevent or treat dehydration, and provide food. In addition, they should receive for 5 days an oral antimicrobial active against *Shigella*, since this is the responsible organism in most cases (up to 60%) of dysentery in children.

It is essential to know the sensitivity of *Shigella* local strains, because antimicrobial resistance is common. A number of

| TABLE 1. Classification of children with diarrhea without dehydration or blood in stools |
|---|---|---|
| **Assess signs** | **Classify** | **Treatment** |
| (GREEN) Not enough signs to classify as dehydration | (GREEN) No dehydration | (GREEN) Give food and fluids for treatment at home (see Plan A in page 21). Tell the mother which signs require immediate medical attention. If diarrhea persists, follow-up in 5 days. |
antimicrobials often used for the management of dysentery, such as amoxicillin and trimethoprim-sulfamethoxazole (TMP/SMX), may be ineffective for treating shigellosis irrespective of the local strain sensitivity. If available, consider ceftriaxone, a fluoroquinolone (in patients older than 18 years), or azithromycin for resistant strains. Ideally a stool culture is performed to identify the organism and guide treatment according to antimicrobial sensitivity. Hospital referral is recommended if the child is malnourished or if there is a previous underlying illness that can complicate the diarrheal disease.

Some regions of Latin America, such as Argentina, have a high incidence of hemolytic uremic syndrome, a very severe condition caused by Shiga toxin-producing strains of *E. coli* and associated with acute renal failure. Antibiotic treatment may precipitate renal failure. In these regions, before starting empiric antibiotic therapy, take a sample of stools for culture that will provide results within 48 hours.

Evidence of improvement in bloody diarrhea include defervescence, less blood in stools, less frequent evacuations, improved appetite, and a return to normal activity. If there is little or no improvement after 2 days, refer the child to a hospital for further evaluation and treatment. If referral is not possible, perform a stool culture in order to identify the organism and adjust antibiotic therapy. If the child is improving, the antimicrobial should be continued for 5 days.

### Amoebic dysentery

Amoebic dysentery is caused by *Entamoeba histolytica*, a protozoan parasite, and also presents with bloody diarrhea. It is transmitted by fecal-oral route, particularly through contaminated water and food. The most severe forms occur in infants, pregnant women, and malnourished children. As in *Shigella*-associated dysentery, the stools often contain visible blood, and diarrhea may be associated with fever and abdominal pain. Hepatomegaly may be present.

Complications include fulminant colitis, toxic megacolon, bowel perforation, and liver abscess.

When a microscopic test reveals amoebic trophozoites or cysts, or when a patient with bloody diarrhea has failed two different antibiotic series, give metronidazole (30 mg/kg/day for 5-10 days).

### Management of persistent diarrhea

Persistent diarrhea is an episode of diarrhea, with or without blood, which begins acutely and lasts at least 14 days. It accounts for up to 15% of all episodes of diarrhea but is associated with 30% to 50% of deaths. Persistent diarrhea is usually associated with weight loss and often with serious non-intestinal infections. Many children who develop persistent diarrhea are malnourished, greatly increasing their risk of death. Persistent diarrhea almost never occurs in infants who are exclusively breastfed.
All children with diarrhea for 14 days or more should be classified based on the presence or absence of any dehydration (Table 2):

- Children with severe persistent diarrhea who also have any degree of dehydration require special treatment and should not be managed at the outpatient facility. Referral to a hospital is required. As a rule, treatment of dehydration should be initiated first, unless there is another severe classification.

- Children with persistent diarrhea and no signs of dehydration can be safely managed in the outpatient clinic, at least initially. Proper feeding is the most important aspect of treatment for most children with persistent diarrhea. The goals of nutritional therapy are to: a) temporarily reduce the amount of animal milk (or lactose) in the diet; b) provide a sufficient intake of energy, protein, vitamins, and minerals to facilitate the repair process in the damaged gut mucosa and improve nutritional status; c) avoid giving foods or drinks that may aggravate the diarrhea; and d) ensure adequate food intake during convalescence to correct any malnutrition.

Routine treatment of persistent diarrhea with antimicrobials is not effective. Some children, however, have nonintestinal (or intestinal) infections that require specific antimicrobial therapy. The persistent diarrhea of such children will not improve until these infections are diagnosed and treated.

**Management of giardiasis**

Giardiasis, an intestinal infestation due to a protozoan parasite, can also cause non-
bloody foul-smelling diarrhea that can be associated with chronic malabsorption. The infection may be asymptomatic or may cause abdominal cramps, epigastric pain, and flatulence. Fever is uncommon. Transmission occurs by fecal-oral route, through contaminated water (particularly surface water), from person to person, or fomites. Even a small inoculum can result in infection.

Consider treatment with metronidazole (15 mg/kg/day for 5 days) for children presenting with chronic, malabsorptive, non-bloody diarrhea without fever, as well as for patients in whom a microscopic stool exam identifies cysts or trophozoites.

**Epidemic cholera**

Cholera is a disease caused by the toxin produced by *Vibrio cholerae*. It is an endemic infection in many parts of the world, including tropical and subtropical areas. Transmission of cholera in disaster situations most frequently involves contaminated water and increased fecal-oral spread related to environmental conditions. *Vibrio cholerae* can survive in water for 7 to 10 days. Contaminated food may also result in outbreaks.

It is important to identify outbreaks as early as possible and take preventive measures. Cholera is a public health emergency. The first suspected case of cholera in an area needs to be confirmed by culture, and public health authorities should be notified immediately.

Confirm the diagnosis with a qualified laboratory and determine antibiotic susceptibility. Once cholera is confirmed in an area, identification of subsequent cases can be based on clinical findings. Since diarrheal illnesses with significant dehydration are common among children, the first recognition of cholera in an area is usually based on the identification of an adult case. Suspect cholera in any adult presenting with severe profuse watery diarrhea and severe dehydration, particularly if the patient dies because of the illness.

Take measures to control the outbreak. Take action to identify milder cases in people who might not seek care. Community efforts should involve improving sanitation, educating families about personal hygiene and food safety, and ensuring a noncontaminated water supply. Occasionally household chlorination or boiling of water will be necessary.

| TABLE 3. Typical electrolyte composition of a cholera stool |
|---------------------------------|----|----|---|----|
|                                | Na⁺ | K⁺ | Cl⁻ | HCO₃⁻ |
| Adult                          | 135 | 15 | 100 | 45  |
| Child                          | 105 | 25 | 90  | 30  |

Clinical manifestations of cholera include painless diarrhea without fever. The volume of stools can vary considerably. In severe cholera, stools have the appearance of rice water. The severe fluid loss can cause shock within the first 4 to 12 hours in untreated patients. Additional findings include anxiety, muscle cramps, weakness (related to electrolyte alterations and hypoglycemia), and altered mental status (Table 3).

Management of cholera
Treatment of patients with oral rehydration solution (ORS) by itself reduces the case fatality rate (CFR) to less than 1%. However, antibiotic therapy with doxycycline, tetracycline, TMP/SMX, erythromycin, chloramphenicol, or fluoroquinolones can reduce the volume and duration of diarrhea, thus helping to limit transmission (Table 4). Fluoroquinolones are indicated when there is multidrug resistance. Manage mental status alterations with glucose to correct possible hypoglycemia. Once cholera is confirmed in an area, monitor CFR to determine the adequacy/availability of rehydration therapy.

TABLE 4. Pediatric antibiotic doses for cholera

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxycycline</td>
<td>6 mg/kg (1 dose)</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>50 mg/kg every 6 hours for 3 days*</td>
</tr>
<tr>
<td>TMP/SMX</td>
<td>5 mg/kg (TMP) every 12 hours for 3 days</td>
</tr>
</tbody>
</table>

*Children >6 years
TMP = trimethoprim; SMX = sulfamethoxazole

Treatment of patients with ORS alone reduces the case fatality rate (CFR) to less than 1%.
DIARRHEA IN INFANTS
0 TO 2 MONTHS OF AGE

OBJECTIVES

- Identify the different types of diarrhea.
- Define treatment for infants 0 to 2 months of age with diarrhea.

In this age group, diarrheal disease has some particular issues. The water content in the stools is higher than normal. Frequent evacuation of normal stools is not diarrhea, and the number of evacuations usually depends on diet and age. In a breastfed infant from 5 to 10 days of age loose stools are normal. If the neonate is in very good general status, with no signs of illness and feeds appropriately, the diagnosis will most probably be transition stools; these do not require treatment. After that period, breastfed infants’ stools continue to be loose, but usually without mucus or blood. The mother of an infant will normally recognize diarrhea because either the consistency of the stools or the frequency of evacuations will differ from normal.

Nevertheless, consider diarrhea in an infant younger than 2 months to be a severe infection and treat it accordingly.

Persistent diarrhea
Consider infants from 0 to 2 months of age with persistent (7 days or more) diarrhea severely ill and refer them to a hospital whenever possible. These patients require special care to prevent fluid loss. It might also be necessary to make dietary changes and to perform laboratory tests to identify the cause of diarrhea (Table 5).

<table>
<thead>
<tr>
<th>Signs</th>
<th>Classify as</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(RED) Diarrhea for 7 days or more</td>
<td>(RED) Persistent diarrhea</td>
<td>URGENT referral to a hospital with mother offering frequent sips of ORS Counsel the mother to continue breastfeeding</td>
</tr>
</tbody>
</table>
Bloody diarrhea

Most frequent causes of bloody diarrhea in the neonate include hemorrhagic disease (due to vitamin K deficiency), allergic colitis, necrotizing enterocolitis, or other coagulation disorders, such as disseminated intravascular coagulation due to sepsis. In infants older than 15 days of age, blood in the stools may result from anal fissures, cow’s milk allergy, or surgical disorders, such as intussusception. Bacterial dysentery is not common in this age group, but when it is suspected, consider Shigella and administer appropriate therapy. Amoebic dysentery is unusual in very young infants.

Consider bloody diarrhea in this age group as severe illness requiring urgent referral to a hospital (Table 6).

Identification of a causal agent is possible in only a small proportion of infants under 2 months old with diarrhea. Infection may occur at birth with organisms present in the mother’s feces, or afterwards by a great variety of organisms from other infected children or the mother’s hands. Infecting agents causing diarrheal diseases in infants younger than 2 months old usually include Escherichia coli, Salmonella, echovirus, and rotavirus.

The disease may start abruptly, associated with poor feeding and/or vomiting. Stools may initially be yellow and loose, then greenish and highly watery, and the number of evacuations may increase. The most ominous feature of the disease is acute fluid loss, resulting in dehydration and electrolytic disorders. Hand washing, exclusive breastfeeding, and early adequate treatment can prevent dehydration and potential death.

**TABLE 6. Classification of bloody diarrhea in infants less than 2 months**

<table>
<thead>
<tr>
<th>Assess signs</th>
<th>Classify as</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(RED) Blood in stools</td>
<td>(RED) Bloody diarrhea</td>
<td>(RED)</td>
</tr>
<tr>
<td>URGENT referral to a hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counsel the mother to continue breastfeeding if tolerated by the infant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give a dose of intramuscular vitamin K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give the first dose of the recommended antibiotics</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dehydration resulting from acute diarrheal illness is one of the most significant causes of morbidity and mortality in populations displaced by disaster. In some cases, it accounts for more than 50% of the deaths during the initial stages of a humanitarian emergency. The use of oral rehydration therapy (ORT) has markedly reduced the morbidity and mortality associated with dehydration caused by diarrheal illness regardless of the etiology.

**Dehydration types**

Dehydration is usually classified into 3 types based on the amount of sodium in the blood: isotonic, hypotonic (hyponatremia), and hypertonic (hypernatremia). In clinical practice, the first 2 can be grouped into a single iso/hypotonic category since they share similar physiologic characteristics, clinical presentations, and treatments. In this case, net water and electrolyte loss is either hypertonic (resulting in hypotonic dehydration) or isotonic (resulting in isotonic dehydration) compared to normal plasma osmolarity. As a result of these losses, extracellular fluid volume (EFV) is significantly reduced, with no or little decrease in intracellular fluid volume (IFV). Reduced EFV is responsible for most of the clinical signs of dehydration, which are therefore very evident.

Hypertonic dehydration occurs when net fluid losses are hypotonic in compari-
son to normal plasma osmolarity. In this case, the osmolar balance between the intracellular and extracellular compartment leads to the shift of water from the intracellular to the extracellular space. Because EFV is thus compensated and less affected, clinical signs of dehydration are less obvious. The loss of intracellular fluid results in intracellular dehydration evidenced by specific clinical features.

**Dehydration degrees**
The most accurate way to assess the degree of dehydration is by calculating the percentage of weight loss. However, a child’s weight prior to the episode is rarely known, and it is usually necessary to rely on clinical signs. Table 7 describes the clinical signs according to different degrees of dehydration.

Even if an accurate assessment of the degree of dehydration might not be possible, a diagnosis of mild (fluid loss <5% of body weight) or severe (fluid loss >10% and usually accompanied by significant hemodynamic disturbance) dehydration can be made through the clinical signs that become visible in each condition.

Remember that decreased skin turgor (skin pinch) may be misleading, since it can be present in malnourished children without dehydration. The Integrated Management of Childhood Illness (IMCI) strategy classifies dehydration and determines its treatment according to clinical findings (Table 8).

**Hypertonic dehydration**
Hypertonic dehydration usually presents with specific features associated with the

<table>
<thead>
<tr>
<th>TABLE 7. Clinical signs according to degrees of dehydration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SIGN</strong></td>
</tr>
<tr>
<td>Enophthalmos</td>
</tr>
<tr>
<td>Mucosus membranes</td>
</tr>
<tr>
<td>Tears</td>
</tr>
<tr>
<td>Fontanelle</td>
</tr>
<tr>
<td>Skin: temperature and color</td>
</tr>
<tr>
<td>Heart rate</td>
</tr>
<tr>
<td>Blood pressure</td>
</tr>
<tr>
<td>Sensorial status</td>
</tr>
<tr>
<td>Capillary refill</td>
</tr>
<tr>
<td>Urine output</td>
</tr>
<tr>
<td>Skin turgor (skin pinch)</td>
</tr>
</tbody>
</table>
SECTION III / DEHYDRATION

The underlying physiologic process that causes it. Risk factors include previous exposure to very hot weather or to heated rooms while wearing too much clothing, resulting in significant sweating with low sodium loss; fever; or the administration of fluids containing too much salt. Typical clinical signs (sunken eyes, decreased skin

<table>
<thead>
<tr>
<th>TABLE 8. Classification of dehydration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess clinical signs</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>(RED) Two of the following signs:</td>
</tr>
<tr>
<td>• Lethargy/unconsciousness</td>
</tr>
<tr>
<td>• Sunken eyes</td>
</tr>
<tr>
<td>• Drinks poorly or unable to drink</td>
</tr>
<tr>
<td>• Skin turgor: skin pinch goes back very slowly to normal</td>
</tr>
<tr>
<td>(YELLOW) Two of the following signs:</td>
</tr>
<tr>
<td>• Restless, irritable</td>
</tr>
<tr>
<td>• Sunken eyes</td>
</tr>
<tr>
<td>• Drinks avidly, shows thirst</td>
</tr>
<tr>
<td>• Skin turgor: skin pinch goes back slowly to normal</td>
</tr>
<tr>
<td>(GREEN) Not enough signs to classify as dehydration</td>
</tr>
<tr>
<td>(GREEN) Give food and fluids adequate to treat diarrhea at home (See Plan A in page 21)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
turgor, hypotension) are less evident than in isotonic or hypotonic dehydration of the same severity. The tendency to develop shock is delayed because the intravascular volume is relatively protected by the water shift from the intracellular space. The patient is usually very irritable, even with very severe degrees of dehydration, and drinks avidly. Seizures and intracranial hemorrhage may occur. For treatment, if ORT has failed or is contraindicated, intravenous (IV) rehydration therapy should correct the electrolytic disorder within 36 to 48 hours. This situation is different in hypotonic dehydration, where IV correction can be attained within a few hours using polyelectrolytic solutions.

Management of dehydration

Oral rehydration therapy

The efficacy and safety of ORT have been proven worldwide. In 1964, the identification of the sodium-glucose cotransport system in the intestinal mucosa led to the development of different solutions for the oral treatment of dehydration. During the 1971 cholera outbreak in Bangladesh, mortality rates from diarrheal illness dropped from 25% to 3% when ORT was introduced instead of IV therapy. In the overwhelming majority of patients with diarrheal illness in a disaster, ORT is effective in preventing and treating the associated dehydration.

Physiologic basis of ORT

In normal physiologic status, water is absorbed osmotically across the small bowel through tight junctions between epithelial cells due to a sodium gradient that is maintained by 2 mechanisms of sodium absorption in the brush border membrane of the luminal cell: passive sodium/potassium diffusion and active cotransport of sodium jointly with monosaccharides such as glucose. The resulting intracellular sodium is then actively transported via ATPase carrier enzymes into the intercellular space, resulting in an osmotic gradient between the intracellular and luminal spaces, allowing for free diffusion of water (Figure 1).

In diarrheal illness, the passive absorptive mechanism of sodium and chloride is impaired, but glucose absorption remains largely intact. This allows the absorption of enough water and sodium to compensate for fluid losses as significant as those seen in cholera. The osmotic gradient in the intercellular space maintains the absorption of potassium and bicarbonate. In this way, the metabolic acidosis usually associated with dehydration can be corrected without the risk of overcorrection.

Advantages of oral rehydration therapy

Oral rehydration therapy has multiple advantages over parenteral rehydration (Box 1). Since ORT uses the normal physiologic mechanisms of intestinal absorption there is no risk of complications, such as water overload or overcorrection of electrolyte and acid-base disturbances associated with dehydration. Thus, ORT can be used in any dehydrated child, regardless of the type of dehydration. Moreover, laboratory tests are not usually necessary for the patient’s evaluation.
Normal hydration in children receiving ORT is usually achieved in 4 to 6 hours, allowing early refeeding, resulting in decreased risk of malnutrition associated with diarrheal disease.

Costs of ORT are minimal compared with those of IV therapy. Moreover, its major ingredients (salt, water, and sugar or starchy foods like rice) are often present in the community when premixed oral rehydration solutions (ORS) are not readily available. ORT is simple and can be given by trained health assistants. In addition, ORT requires the participation of the mother, thus encouraging family involvement in the child’s health. Because its requirements are minimal, ORT can be used at the site of the disaster, reducing the demands on medical hospital-based personnel and allowing patients to be in close contact with their families (Box 2). Lastly, complications associated with invasive procedures, such as IV therapy, particularly infections, are totally avoided.

**Composition of oral rehydration solution**
The most widely used formulation for oral rehydration is the one designed by the World Health Organization (WHO).
The most important feature of this solution is the inclusion of equimolar quantities of sodium and glucose, which enhances the intestinal absorption of both molecules. The solution also contains a source of bases (bicarbonate or citrate) and potassium (Box 3).

Despite initial concerns for hypernatremia associated to the use of the WHO solution, particularly in hypertonic dehydration, the ORS has been proven to be efficacious and safe, regardless the patient's serum sodium. The WHO ORS does not reduce the duration or intensity of diarrhea. For this reason, research has focused on alternative formulations with different components, such as the use of amino acids as cotransporting molecules; solutions derived from cooked cereals, usually rice-based; and glucose-based ORS with lower osmolarity. Amino acid–based formulations have not been proven significantly beneficial. Rice-based formulations have demonstrated improved efficacy in patients with cholera. They may be used in situations where rice is readily available.

A number of studies have demonstrated that lowering the concentrations of glucose and sodium to a total osmolarity of 245 mOsm/L can decrease stool output and vomiting in children with acute non-cholera diarrhea, without significantly compromising efficacy in cholera patients. Based on these findings, the WHO has recently recommended the use of hypo-osmolar solution, particularly for children with acute, non-cholera diarrhea.

In situations where prepackaged ORS is not available, rehydration can be performed with different extemporaneous solutions. The simplest requires rice, water, and salt. One hundred grams of rice is cooked in 1 liter of boiling water for 10 minutes or until the rice pops. The water is then drained from the rice into a container, and any remaining water is squeezed from the rice with a spoon. When all the water is squeezed from the rice, enough water is added to the solu-

---

**BOX 1. Advantages of ORT**
- Use of normal physiologic mechanisms
- Early refeeding
- 90%-95% effective
- Effective for all types of dehydration
- No need for laboratory tests
- Low economic and social cost
- Availability
- No infectious, metabolic, or electrolytic complications

**BOX 2. Requirements for ORT**
- Oral rehydration salt packets
- Drinking water
- Refrigerator
- Watch
- Pencil and paper
- Scale
- Containers (feeding bottles, glasses, pitchers)
- Nasogastric tube
- Trained staff
SECTION III / DEHYDRATION

BOX 3. Composition of WHO oral rehydration solution

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl</td>
<td>3.5 g</td>
<td>Na+ 90 mEq/L</td>
</tr>
<tr>
<td>KCl</td>
<td>1.5 g</td>
<td>K+ 20 mEq/L</td>
</tr>
<tr>
<td>NaHCO₃</td>
<td>2.5 g*</td>
<td>HCO₃⁻ 30 mmol/L</td>
</tr>
<tr>
<td>Glucose</td>
<td>20 g/L</td>
<td>Dextrose 111 mmol/L</td>
</tr>
<tr>
<td>Water</td>
<td>1 L</td>
<td></td>
</tr>
</tbody>
</table>

* Bicarbonate has currently been replaced with trisodium citrate dehydrate (2.9 g, 10 mOsm/L) for better preservation.

Dehydration management with the IMCI guidelines
The IMCI guidelines for the management of dehydration in children with diarrhea include 3 plans. Administer Plan A (page 21) to children with diarrhea but without dehydration or to those who have been successfully rehydrated. Plan B (page 22) is for children with mild-moderate dehydration, and Plan C (page 23) is for severe dehydration.

Contraindications for ORT
Contraindications for ORT are listed in Box 4. The presence of other severe disease, such as sepsis or meningitis, also contraindicates the use of ORT, but vomiting before or during ORT is not a contraindication. Only untreatable vomiting will require parenteral therapy.

The presence of severe hemodynamic disturbances prompts immediate IV fluid replacement. However, if no supplies are available, perform ORT until IV treatment is possible.

Before starting ORT, auscultate the abdomen to check for the presence of bowel sounds and rule out a diarrhea-related ileus (severe hypokalemia, anti-spasmodic-drug toxicity).

- Shock
- Patient younger than 1 month of age
- Ileus
- Significantly altered sensorium
- Severe difficulty breathing
- Painful abdominal distension
Organization of ORT units in disaster settings

Because morbidity and mortality associated with diarrhea can be significantly reduced by early hydration, set up ORT units at the onset of almost every disaster relief situation. Very few supplies are needed, and it is easy to train auxiliary personnel in the IMCI approach to ORT.

The supplies needed to set up an ORT unit include a sufficient number of ORS packets, if possible, an adequate amount of drinking water, and the rest of the items previously mentioned.

The staff in charge of the unit must keep records of the patients treated and should be trained to identify cases of severe dehydration and suspected cases of cholera. Such records are essential for surveillance purposes, and the information obtained will prove useful in improving public health interventions in disaster situations.
PLAN A: TREAT DIARRHEA AT HOME

Use Plan A to teach the mother to:
- Continue to treat her child’s current episode of diarrhea at home
- Give early treatment for future episodes of diarrhea

Explain the 3 rules for treating diarrhea at home:

1. Give the child more fluids than usual to prevent dehydration:
   - Use a recommended home fluid, such as cereal gruel. If this is not possible, give plain water while preparing an adequate solution, or use ORS after each evacuation.
   - Give as much of these fluids as the child will take.
   - Continue giving these fluids until the diarrhea stops.

2. Give the child enough food to prevent malnutrition.
   - Continue breastfeeding.
   - If the child is not breastfed, give the usual milk. If the child is younger than 6 months old and not yet taking solid food, offer milk more frequently, —as much as the child will take.
   - If the child is older than 6 months old and already taking solid food give:
     - Cereal, pasta, or potato mixed with legumes, vegetables, and beef or chicken. Add 1 or 2 teaspoons of vegetable oil to each serving.
     - Fresh fruit juice, coconut milk, or mashed banana to provide potassium.
     - Freshly prepared ground or mashed foods.
     - Encourage the child to eat by offering food at least 6 times a day.
     - After diarrhea stops, give an extra meal each day for 2 weeks, until the child’s weight before illness is attained.

3. Take the child to a health care worker if he or she does not get better in 3 days or develops any of the following:
   - Many watery stools
   - Poor eating or drinking
   - Repeated vomiting
   - Fever
   - Marked thirst
   - Blood in the stools

Children should be given ORS at home if:
- They have received treatment with Plan B or Plan C.
- They cannot return to the health care worker.

Show the mother the amount of ORS to use
If the child will receive ORS at home, show the mother the amount to be given after each evacuation and give her enough packets of ORS for 2 days.

<table>
<thead>
<tr>
<th>Age</th>
<th>Amount of ORS to give after each loose stool</th>
<th>Amount of ORS to provide for use at home</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 years</td>
<td>50-100 mL</td>
<td>1 packet per day</td>
</tr>
<tr>
<td>2 to 10 years</td>
<td>100-200 mL</td>
<td>2 packets per day</td>
</tr>
<tr>
<td>10 years or more</td>
<td>As much as wanted</td>
<td>4 packets per day</td>
</tr>
</tbody>
</table>

Show the mother how to mix ORS
- Give teaspoonfuls frequently to a child under 1 year of age.
- Give frequent sips from a cup to an older child.
- If the child vomits, wait 10 minutes and then give the solution more slowly (for example, a teaspoonful every 2 minutes).
- If diarrhea continues after 2 days, tell the mother to give other fluids as described above or to return for more ORS packets.
**PLAN B: TREAT DEHYDRATION**

Calculate the amount of ORS to give in the first 4 hours

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>VOLUME (50-100 mL/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>150-300</td>
</tr>
<tr>
<td>5</td>
<td>250-500</td>
</tr>
<tr>
<td>8</td>
<td>400-800</td>
</tr>
<tr>
<td>10</td>
<td>500-1,000</td>
</tr>
<tr>
<td>15</td>
<td>750-1,500</td>
</tr>
<tr>
<td>18</td>
<td>900-1,800</td>
</tr>
<tr>
<td>25</td>
<td>1,250-2,500</td>
</tr>
<tr>
<td>30</td>
<td>1,500-3,000</td>
</tr>
<tr>
<td>40</td>
<td>2,000-4,000</td>
</tr>
<tr>
<td>60</td>
<td>3,000-6,000</td>
</tr>
</tbody>
</table>

The amount of ORS to be given in the first 4 hours is calculated by multiplying the patient’s body weight in kilograms by 50 mL to 100 mL, based on the degree of dehydration. Extremely dehydrated patients without shock may receive up to 150 mL/kg.

- If the patient wants more than the recommended amount, give more.
- Continue breastfeeding.
- If weight is not known, continue to give the solution until the patient does not want any more.

**Observe the child closely and help give the ORS**

- Show how much solution to give the child.
- Show how to give the solution:
  - Child <1 year: 1 teaspoonful at a time administered continuously.
  - Child >1 year: frequent sips from a cup.
- Check to see if the solution is being administered correctly.
- Assess changes in the patient’s condition every hour.

If the child vomits, wait 10 minutes and then give the solution more slowly (for example, a teaspoonful every 2 minutes). Later give ORS continuously. If vomiting persists, give the solution through a nasogastric tube.

After 4 hours, reassess the child. Then select Plan A, B, or C to continue treatment.

- If there are no signs of dehydration, shift to Plan A.
- If signs indicate that some dehydration is still present, repeat Plan B and reassess 2 hours later.
- If signs indicate that severe dehydration has occurred, shift to Plan C.

If the mother must leave before treatment is complete

Start rehydration and assess the patient frequently. If after 2 hours the patient is receiving the solution without problems, is not vomiting, and is recovering:

- Show the mother or caregiver how to continue with the rest of the 4-hour treatment at home.
- Supply enough ORS packets to complete rehydration and to continue for 2 more days as described in Plan A.
- Show how to prepare the ORS.

**Explain the 3 rules in Plan A for treating her child at home:**

- Give ORS or other fluids continuously until diarrhea stops.
- Feed the patient.
- Come back to the health care worker, if necessary.

ORT is assumed to have failed if the child is not adequately rehydrated within 6 hours. In this case it is necessary to shift to IV hydration.
**PLAN C: TREAT SEVERE DEHYDRATION EARLY**

- Follow the arrows: if the answer is yes, go to the right; if the answer is no, go down.

**Can you give IV fluids immediately?**

**Start IV fluids immediately.** If the patient can drink, give ORS by mouth while the drip is set up. Give 100 mL/kg of polyelectrolytic solutions (WHO formula) or, if not available, normal saline, divided as follows:

<table>
<thead>
<tr>
<th>Age</th>
<th>Normal saline 30 mL/kg initially in</th>
<th>Then give 70 mL/kg in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants (&lt;1 yr)</td>
<td>1 hour</td>
<td>5 hours</td>
</tr>
<tr>
<td>Small children (12 mo-4 yr)</td>
<td>30 minutes</td>
<td>2 1/2 hours</td>
</tr>
</tbody>
</table>

- Reassess the patient every half hour. If hydration is not improving, give the IV drip more rapidly.
- Also give ORS (about 5 mL/kg/h) as soon as the patient can drink.
- After 3 hours evaluate the patient and choose the appropriate plan (A, B, or C) to continue treatment.

**Is IV treatment available nearby (within 30 minutes)?**

- Refer to hospital IMMEDIATELY for IV treatment.
- If the patient can drink, provide the mother with ORS and show her how to give sips of it during the trip.

**Are you trained to use a nasogastric tube for rehydration?**

- Start rehydration by nasogastric tube or by mouth with ORS: give 20 mL/kg per hour.
- Refer URGENTLY to hospital.

**Can the patient drink?**

- Refer URGENTLY to hospital for IV treatment.

**ATTENTION:**

If possible, observe the child for at least the first 6 hours after dehydration in order to make sure that the mother is able to keep the child normally hydrated. She must give the patient ORS and feed him or her.
SUMMARY

Diarrheal disease and dehydration—its most common complication—are the main causes of morbidity and mortality in populations exposed to a disaster. There are different types of diarrhea caused by different pathogens. The causative agent can be suspected from the clinical manifestations, which help in selecting the initial treatment.

ORT and continued feeding (especially breastfeeding) have notably reduced the morbidity and mortality classically associated with diarrhea and dehydration. The substantial advantages of ORT over IV therapy make it the ideal tool in humanitarian emergencies involving large displaced populations.

The IMCI strategy is a fundamental tool of primary care in emergency settings because it makes use of available resources to provide safe and effective treatment.

SUGGESTED READING

Atención integrada a las enfermedades prevalentes de la infancia en Argentina. OPS Washington DC, 2005


Case resolution

1-3. Based on the frequency of the evacuations and the characteristics of the stools, the infant has acute diarrhea. There is no blood in the stools, so the most probable causative agent is rotavirus or *E. coli*. In both cases the disease is usually self-limited and does not require antibiotic therapy. Since the child is not dehydrated, advise the mother to give him ORS after every evacuation of loose stools, to provide more fluids than usually, and to continue breastfeeding and giving the child the other foods he usually eats. Determine if other household contacts are similarly affected, which might indicate an outbreak. If adults are experiencing significant watery diarrhea with dehydration, suspect *V. cholerae* infection.

Continued breastfeeding is an important way to reduce potential recurrences. Intensify hygiene measures, and provide adequate water supply and stool disposal.

4. Upon his return, the child presents with more than 2 signs in the IMCI classification for severe dehydration. There are no other signs of severe disease, but there are findings consistent with hemodynamic disorder (shock). Begin immediate treatment for severe dehydration (Plan C in the IMCI guidelines). Once rehydration has been achieved, the child should be switched to a maintenance plan (Plan A) and reassessed in 24 hours. Because there is no history of cholera in the population, antibiotic therapy is not needed.
MODULE REVIEW

SECTION I - DIARRHEAL ILLNESSES

1. What clinical features characterize the different types of diarrhea, and what are the most frequent etiologic agents for each type?
2. What are the fundamental components of the treatment of diarrhea?
3. Why is nutrition important in the treatment of diarrhea?
4. What steps do the IMCI guidelines recommend for treating diarrhea without blood in the stools and for dysentery?
5. What treatment is indicated for the various agents responsible for bloody diarrhea?
6. What are the causes of persistent diarrhea and what is the treatment?
7. What are the characteristics of epidemic cholera, and what is the appropriate approach to managing an outbreak in an emergency setting?

SECTION II - DIARRHEA IN THE INFANT 0 TO 2 MONTHS OF AGE

1. How should diarrhea be treated in the infant 0 to 2 months?
2. What is the approach to managing persistent diarrhea in this age group?
3. What is the treatment for bloody diarrhea in this age group?

SECTION III - DEHYDRATION

1. What physiologic and clinical features differentiate isotonic and hypotonic dehydration from hypertonic dehydration?
2. What is the physiologic basis of oral rehydration therapy (ORT)?
3. How should ORT be administered, and what supplies are needed to implement ORT?
4. What are the advantages and contraindications of ORT?
5. What variables do the IMCI guidelines use to classify dehydrated children and to determine their treatment?
6. What is the appropriate approach to managing severe dehydration in children?
MODULE 7

Delivery and Immediate Neonatal Care

William Keenan | Enrique Udaeta | Mariana López | Susan Niermeyer
INTRODUCTION

Approximately 1 million neonatal deaths occur each year due to perinatal asphyxia. It is one of the leading causes of perinatal and neonatal mortality and is associated with a very high incidence of irreversible neurologic damage. Prompt and skilled resuscitation can prevent many of these deaths and reduce disability in survivors. Under ordinary circumstances, about 1 in 10 newly born infants will require some resuscitation intervention. This proportion is higher during periods of social and environmental stress.

The ABC principles of resuscitation are the same for all age groups. The airway must be open, breathing must be adequate, whether spontaneous or assisted, and circulation of oxygenated blood must take place.

Neonatal jaundice is also extremely common and since it can be associated with serious pathologies, this module will address the management of this complication.
DELIVERY AND IMMEDIATE NEONATAL CARE

OBJECTIVES

- List the elements needed to successfully carry out neonatal resuscitation, including recognition of risk factors associated with the need for neonatal resuscitation and preparation of the environment, personnel, and the equipment necessary for neonatal resuscitation.
- Identify the newborn who is making a normal transition immediately after birth.
- Recognize the newborn who requires resuscitation.
- Describe and apply effective neonatal resuscitation interventions.

Anticipation, preparation, recognition, and intervention
A successful resuscitation relies on anticipation based on prenatal and intrapartum risk factors, preparation for all deliveries, recognition of the need for resuscitation, and adequately skilled intervention.

Make an obstetrical assessment for any pregnant woman who has a fever or other illness, or who is in labor or premature rupture of membranes (PROM) before the onset of labor. Refer to a maternal and child health service whenever feasible and appropriate. Give all human immunodeficiency virus (HIV)-positive pregnant women antiretroviral medications as indicated.

Anticipatory planning
Every disaster situation is likely to involve pregnant women and their newborns. Because more than 10% of newly born infants will require resus-

CASE.
You are delivering health care at a shelter for people displaced following an earthquake. A 15-year-old comes to the health care post. She is in labor and had spontaneous rupture of membranes 2 hours earlier. The amniotic fluid is clear. She has had only one prenatal checkup, at 5 months of pregnancy. According to the date of her last period, she is in the 39th week of gestation. Immediate assessment reveals that she is currently hypertensive, and fetal bradycardia is detected through auscultation.

- Which are the risk factors in this patient?
- Which elements are crucial to ensure adequate neonatal care?
citation, anticipatory planning will be fundamental for these interventions to be successful.

**What personnel should be available?**
If possible, notify personnel with skills in neonatal resuscitation. At least one person who is capable of initiating resuscitation should be present at each birth and immediately available to the newborn. Others who might function as part of a resuscitation team should be available as the need arises. It is important to prepare the area in which the delivery will occur, check the equipment and review the functions of personnel immediately prior to the delivery. Personnel should review the emergency plan for communication and transportation if either mother or infant needs an advanced level of care.

**What maternal, fetal, and neonatal conditions might indicate a higher risk of neonatal depression?**
The need for resuscitation cannot always be predicted; it must be kept in mind that prompt neonatal resuscitation might be necessary after any birth. However, some perinatal conditions associated with a need for resuscitation can be recognized in advance. Some of those conditions are shown in Box 1. Thorough assessment of the risk factors allows for the identification of more than half of the deliveries that will need neonatal resuscitation. Prospective identification of perinatal high-risk factors should prompt

**BOX 1. Risk factors associated with probable need for neonatal resuscitation**

**Before delivery**
- Maternal diabetes
- Maternal hypertension
- Anemia or isoimmunization
- Previous fetal/neonatal death
- Post-term gestation
- Multiple gestation
- Polyhydramnios or oligohydramnios
- Premature (pre-labor) rupture of membranes (PROM)
- Maternal infection
- Maternal consumption of drugs or medications
- Any other maternal illness
- Diminished fetal activity
- Known fetal malformations
- Lack of prenatal care
- Maternal age <19 or >35 years old

**During delivery**
- Labor at less than 8 completed months of pregnancy
- Rapid labor
- Emergency cesarean section or use of forceps
- Prolonged PROM
- Fetal distress (alterations in the fetal heart rate)
- Significant vaginal bleeding
- Placental abruption
- Prolonged labor according to evaluation by partogram
- Meconium-stained amniotic fluid
- Umbilical cord prolapse and tight nuchal cord
- Anticipated low birth weight
- Anticipated high birth weight
the transfer of the pregnant woman or the mother and her newly born infant to facilities with enhanced care resources. Keep the mother and baby together, especially if transfer is necessary. The Integrated Management of Childhood Illness (IMCI) strategy from the Pan American Health Organization (PAHO) and the World Health Organization (WHO) includes the assessment and classification of pregnancies in order to determine the risk level and adequate treatment (Table 1). Identification of high-risk factors can also facilitate communication with the family and timely mobilization of the resuscitation and maternal health care team.

What equipment should be available?
It is recommended that sterile delivery kits be available. An example of the contents of a delivery kit is provided in Box 2.

A neonatal-sized resuscitation bag or other device capable of giving controlled positive pressure with appropriately sized face masks should also be available. The use of endotracheal tubes, laryngoscopes, intravenous administration sets, and medications is dictated by availability of supplies and personnel skilled in their use. For further details consult a more advanced source, such as the sixth edition of *Textbook of Neonatal Resuscitation* from the American Academy of Pediatrics (AAP) and the American Heart Association (AHA).

### Box 2. Sample delivery kit

**Before delivery**
- Cord clamps or ties (at least 2)
- Razor blade or sharp scissors
- Material for hand hygiene—either an alcohol-based hand-cleaning solution or a bar of soap and clean water
- Clean cloths (at least 2) to be used for drying and wrapping the infant

**What are the appropriate delivery procedures?**
It is essential to utilize appropriate personal protection; personnel should use sterile gloves to the extent possible.

Clamp or securely tie the umbilical cord with sterile string about 2 and 5 finger breadths from the abdomen. Cut the cord between the occluded sites with a sterile blade or scissors; avoid contamination. A short delay of 1 to 3 minutes between birth and cord ligature or clamping benefits vigorous infants. Some recommend that, if time allows, the cord be clamped only after visible pulsation has stopped.

Remember to perform adequate identification procedures for the newborn (take the infant’s footprints in a form together with the mother’s fingerprint and provide the newborn with an identification bracelet, if avail-
TABLE 1. Classification to assess and determine pregnancy risk

<table>
<thead>
<tr>
<th>Assess signs</th>
<th>Classify as</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of the following signs:</td>
<td>(RED) Pregnancy with imminent risk</td>
<td>(RED) Refer URGENTLY to hospital of higher level of complexity, lying on the left side</td>
</tr>
<tr>
<td>• Labor at &lt;37 w</td>
<td>(RED) Prevention with imminent risk</td>
<td>(RED) Prevent hypotension</td>
</tr>
<tr>
<td>• Pregnancy at &gt;41 w</td>
<td>(RED) Prevent hypertension</td>
<td>(RED) In case of preterm labor: inhibit contractions and give corticoids</td>
</tr>
<tr>
<td>• Reduced or absent fetal movements</td>
<td>(RED) Prevent infection</td>
<td>(RED) If PROM with fever: give first dose of adequate antibiotic</td>
</tr>
<tr>
<td>• Severe systemic disease</td>
<td>(RED) Prevent infection</td>
<td>(RED) Administer oxygen as necessary</td>
</tr>
<tr>
<td>• Infection with fever (UTI, bacterial or viral sepsis, chorioamnionitis, malaria)</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• Uncontrolled diabetes</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• Vaginal bleeding</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• Pre-labor rupture of membranes (PROM) &gt;12 h</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• Uncontrolled hypertension and/or seizures, blurred vision, loss of consciousness or intense headache</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• Changes in fetal cardiac frequency (FCF)</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• Intense palm pallor and/or Hb &lt;7 g/dL</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• Swollen face, hands and legs</td>
<td>(RED) Prevent infection</td>
<td></td>
</tr>
<tr>
<td>• less than 19 or more than 35 y of age</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Refer to specialist clinics</td>
</tr>
<tr>
<td>• Primiparity or grand multiparity</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) If multiple gestation: refer before week 30</td>
</tr>
<tr>
<td>• No prenatal care</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) If VDRL positive: start treatment with penicillin benzathine</td>
</tr>
<tr>
<td>• Less than 2 years between pregnancies</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Counsel the mother to follow the indicated treatment</td>
</tr>
<tr>
<td>• Uterine height does not correlate with gestational age</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Vaccinate with tetanus toxoid</td>
</tr>
<tr>
<td>• Previous cesarean section</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Counsel on HIV-AIDS and sexually transmitted diseases (STD)</td>
</tr>
<tr>
<td>• History of prematurity, low-birth weight or malformations</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Schedule next visit</td>
</tr>
<tr>
<td>• History of recurrent abortions, fetal or early neonatal death</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Counsel on nutrition, pregnancy care, and breastfeeding</td>
</tr>
<tr>
<td>• Controlled systemic disease</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Teach danger signs</td>
</tr>
<tr>
<td>• Urinary infection without fever</td>
<td>(YELLOW) High-risk pregnancy</td>
<td>(YELLOW) Plan referral with the family in advance, according to risk factors and feasibility of the solutions</td>
</tr>
<tr>
<td>• Controlled diabetes</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Palm pallor and/or Hb 8-10 g/dL</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Vaginal discharge</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• On teratogenic medications</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Alcoholism, drug-addiction or smoker</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Controlled hypertension</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Inadequate weight gain</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Abnormal fetal presentation</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Multiple gestation</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• Rh negative mother</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
<tr>
<td>• VDRL, HIV or HBV positive</td>
<td>(YELLOW) High-risk pregnancy</td>
<td></td>
</tr>
</tbody>
</table>

able). This issue takes on added importance in situations of administrative disorder, as is usually the case in acute humanitarian emergencies.

Provide the child with an environment as warm as possible. It is essential to dry the infant immediately. Leaving the baby wet may result in cold stress. Early skin-to-skin contact with the mother has been shown to be effective and desirable. Immediate breastfeeding following delivery is advisable for healthy infants. Even if the newborn requires resuscitation and ongoing care, present him to the mother at least briefly.

Recognition

Three major questions should be asked about every newly born child to define the need for resuscitation:

• **Is this a full-term gestation?** For a variety of reasons, a preterm baby is much more likely to require interventions. Moreover, in case resuscitation is needed, preterm newborns’ anatomic and physiologic characteristics are different from those in term newborns, and these differences should be taken into consideration: pulmonary surfactant is often insufficient, which leads to difficult ventilation; skin is thinner and permeable; skin area is larger and there is less subcutaneous tissue, which increases heat dissipation; more vulnerability to infection; more fragile cerebral capillaries, with increased probability of CNS hemorrhage under situations of stress.

• **Is the baby breathing or crying?** Absent respiratory effort (apnea) or inadequate respiratory effort (gasperping; breathing with superficial and ineffective inspiratory movements) is the first reason to initiate resuscitation.

• **Is there good muscle tone?** Poor muscle tone might indicate hypoxemia. Preterm newborns normally have a lower muscle tone than term babies. Term infants with good respiratory effort and muscle tone can be dried and placed over the mother’s body for better thermal protection and suckling under continued observation.

Resuscitation treatment

The sequence of neonatal resuscitation for the baby with identified risks (preterm, poor or no respiratory effort, or poor muscle tone) begins with thermal protection, proper positioning of the newborn, and brief stimulation. Attending personnel should observe hand hygiene and protect the baby from contamination at all times.

• **Thermal protection.** Dry the baby rapidly to reduce evaporation. A radiant heater can be used if available. If a warming device is used, hyperthermia must be avoided. If resuscitation interventions are required, wrapping a very preterm infant in clear food-grade plastic film is effective in reducing cold stress while allowing access to the infant. Cover the baby’s head with a cap. A sick baby who needs to be transported can be protected from cold by placing an exothermic chemical mattress under a blanket,
skin-to-skin contact with an adult, or swaddling in warm blankets covered by a windproof, reflective outer layer. Heating pads, hot water bottles, and surgical gloves filled with hot water should be avoided because they can cause extensive burns.

- **Position.** The airway of the hypotonic baby is vulnerable to obstruction with flexion or extension of the neck. Position the infant on the back or side, with the head slightly extended in the “sniffing” position (Figure 1). A small roll of cloth placed under the shoulders may be helpful in maintaining head position.
- **Airway clearing.** Remove secretions that obstruct the airway by wiping the nose and mouth with a cloth or by using a suction device. Suction the mouth before the nose (Figure 2). Suction must be gentle and not very deep. Roughly suctioning or touching the posterior wall of the pharynx with the suctioning device may cause apnea and bradycardia through vagal stimulation. The presence of meconium in the amniotic fluid can be a sign of fetal distress. Pharyngeal suctioning during birth has not been demonstrated to reduce the incidence of meconium aspiration syndrome. When the baby is meconium-stained and not immediately vigorous (vigorous = strong cry, good muscle tone, and heart rate above 100 beats/ min), tracheal suctioning should be considered. Personnel skilled in neonatal tracheal intubation and proper equipment would be required for this step.
- **Stimulation.** Drying an infant thoroughly generally provides sufficient stimulation of breathing in a healthy newborn. Additional stimulation—flicking the soles of the feet or

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**FIGURE 1.** Correct and incorrect head positions for resuscitation

![Correct and Incorrect Head Positions](image-url)
rubbing the back, for example—may encourage the initial respiratory effort and continued breathing during the early transitional period if needed. Vigorous or prolonged stimulation may cause great harm to the baby and is not part of skillful resuscitation. Table 2 lists some inadequate stimulation procedures and the harmful consequences that may ensue.

If supplemental oxygen is available, when is it indicated?

A number of studies have demonstrated that for most neonatal resuscitations requiring positive-pressure ventilation, room air is as effective as 100% oxygen. Data also indicate that in the first several minutes after birth cyanosis is common in babies who have normal outcomes.

The AAP Neonatal Resuscitation Program 2011 update includes the following recommendations for oxygen supply during resuscitation:

### FIGURE 2. Suctioning the mouth and nose; “M” [mouth] before “N” [nose]

Mouth first

Then nose

### TABLE 2. Inadequate stimulation procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clapping on the back</td>
<td>Contusions</td>
</tr>
<tr>
<td>Squeezing the chest wall</td>
<td>Fractures, pneumothorax, severe difficult breathing, death</td>
</tr>
<tr>
<td>Pressing the lower extremities over the abdomen</td>
<td>Liver or spleen rupture</td>
</tr>
<tr>
<td>Anal sphincter dilation</td>
<td>Sphincter lesion</td>
</tr>
<tr>
<td>Cold or hot compresses or bathing</td>
<td>Hyperthermia, hypothermia, burns</td>
</tr>
<tr>
<td>Shaking</td>
<td>Hemorrhages or brain damage</td>
</tr>
</tbody>
</table>

Room air to initiate positive-pressure ventilation in term infants and availability of moderate oxygen concentrations for initiation of PPV in very preterm infants.

Oximetry when
- Resuscitation can be anticipated
- Positive pressure is administered for more than a few breaths
- Cyanosis is persistent
- Supplementary oxygen is administered

Targets for oxygen saturation correspond to preductal saturations of healthy term babies in the first minutes after vaginal birth at sea level.

These initial steps and possible subsequent actions are outlined in the flow diagram shown in Figure 3. Further steps in resuscitation are discussed in the following paragraphs.

**FIGURE 3. Flow diagram for neonatal resuscitation**

*Epinephrine IV 0.01-0.03 mg/kg. Adapted from Kattwinkel J, ed. Textbook of Neonatal Resuscitation. 6th ed. AAP/AHA; 2011.*
Additional neonatal resuscitation procedures

Evaluation for further resuscitation interventions
At the completion of the initial steps (thermal protection, positioning, clearing of the airway, and stimulation), respirations and heart rate.

Respiration
There should be adequate respiration as judged by chest movements and respiratory rate.

Ventilation
Poor respiratory effort, as manifested by apnea or gasping (deep, intermittent, slow, spasmodic inspiratory efforts), is the major indication to initiate neonatal resuscitation, and ventilation is the key to successful resuscitation. If the newborn does not rapidly establish effective spontaneous respiration, positive-pressure ventilation must be administered immediately.

What are the elements of positive-pressure ventilation?
The goal of positive-pressure ventilation is to inflate the lungs with an adequate breath. Inspirations that are too small will be ineffective for those in most need, and inspirations that are too large can damage the lungs. The effectiveness of ventilation can be judged as outlined in Box 3.

Many kinds of devices deliver positive-pressure ventilation for neonatal resuscitation. Flow-inflating bags, T-piece devices, one-way valve masks, and laryngeal masks are some of these devices. Most critical is the skill of the person who is operating any of these devices. Potential resuscitators should review the operation of the available devices, practice mock resuscitations, and test the operation of all bags, valves, connections, and safety features. Figure 4 illustrates the use of a self-inflating bag with a mask. The head is slightly extended. The mask covers the mouth and the nose. The fingers of the left hand lift the chin forward and upward and partially encircle the mask, placing light and even pressure downward onto the face to help create an adequate seal. The best indication of adequate lung inflation is the improvement in heart rate, color, and muscle tone.

How is positive pressure delivered?
A good seal with the mask and good positioning are essential. The recommended respiratory rate is 40 to 60 breaths per minute.
60 breaths per minute as illustrated in Figure 5.

What if bag and mask ventilation is not effective?
If the patient is not improving, the most frequent cause is poor delivery of positive pressure. Failure to administer adequate positive pressure may be due to one of three common problems:

- An inadequate seal of the mask to the face:
  - Reapply the mask to the face and lift the jaw up towards the mask.
- A blocked airway:
  - Reposition the head to regain slight extension.
  - Then check for secretions in the nose and the mouth.
  - Then slightly open the mouth and continue positive-pressure ventilation.

Box 3. Signs of effective positive pressure ventilation
- Patient responds
  - Rapid improvement in heart rate
  - Improvement in skin color and muscle tone
  - Breath sounds heard by auscultation over the chest
  - Slight rise and fall in the chest

Figure 4. Light pressure on the mask when lifting upward on the chin will help create a seal. Anterior pressure on the posterior rim of the mandible (not shown) may also help open the airway.

Figure 5. Counting out loud to maintain a rate of 40 to 60 breaths per minute

Breathe.......
(squeeze)

Two....... Three....... 
(release)

Breathe.......
(squeeze)

Two....... Three....... 
(release)
• Need for larger breath:
  - Increase the inflation pressure to achieve a slight rise and fall in the chest with each breath

**What if the requirement for bag and mask ventilation is prolonged?**
The inflations might distend the stomach and interfere with ventilation. In this case, insert a small plastic or rubber catheter through the mouth, aspirate the stomach contents, and fix the open end of the tube to allow continuous drainage.

Ask an assistant to check the heart rate during positive-pressure ventilation or pause ventilation after 1 minute to check the heart rate if you are alone. The normal heart rate is greater than 100 beats per minute. The pulse at this time can be felt easiest at the base of the umbilical cord or can be heard with a stethoscope over the left side of the chest.

**Chest compressions**

**When should chest compressions be initiated?**
Chest compressions are added to positive-pressure ventilation if the heart rate stays below 60 beats per minute after 1 minute of positive-pressure ventilation.

**How should chest compressions be performed?**
Encircle the chest with both hands, thumbs on the lower third of the sternum, and quickly compress to one third of the chest depth to generate a palpable pulse.

Note that ventilation should be continued and coordinated with the compressions. The thumbs are never lifted off the chest during the compression cycles *(Figure 6).*

**How is positive-pressure ventilation coordinated with chest compressions?**
In order to adequately perform both resuscitation procedures, have a second person available to give cardiac compressions. Coordinate the procedures to perform 1 breath every 3 compressions, and count aloud following a rhythm of: “one and two and three and breathe, one and two and three and breathe….” The recommended rate is to deliver 90 compressions and 30 ventilations per minute.

The baby should attain a pink color in the trunk and mucous membranes. If cyanosis persists in these areas, the infant is hypoxemic. Blended oxygen should be administered as guided by pulse oximetry.

**Other common questions regarding neonatal resuscitation**

**How quickly should resuscitation be started?**
Prompt resuscitation is the most effective. If the infant is apneic, gasping, or breathing ineffectively after drying, clearing the airway, and providing additional stimulation, begin positive-pressure ventilation. Usually the new-
How quickly should cardiac compressions be initiated?
Initiate cardiac compressions if the heart rate remains <60 beats per minute after the first minute of positive-pressure ventilation (Figure 3).

Are delays or interruptions of resuscitation harmful?
Animal data indicate that delays in resuscitation significantly diminish its effectiveness. Experiences with adults show that even brief interruptions in resuscitation support are harmful.

Are there indications for not starting resuscitation?
Dramatic circumstances, such as extreme prematurity or severe congenital malformations, may be such indications. Clinical judgment and discussion with the parents should be emphasized.

If resuscitation has been done and life-sustaining therapies then seem undesirable, can treatments be stopped?
Most experts agree that resuscitation does not commit a child to future non-beneficial treatment.

If a baby does not respond to resuscitation, how long should the procedures be continued?
Current data indicate that after 10 minutes with no heart rate in a newborn, an infant’s survival without very severe damage is unlikely.

Post-resuscitation management
The child must be thoroughly monitored and evaluated in the hours and days following resuscitation. Consider arrangements for advanced care for any of the following:
- Birth weight <1500 g
- Difficult breathing
- Unstable temperature (normal axillary temperature: 36.5–37.5°C), persistent cyanosis, pallor, recurrent apnea, seizures, poor responsiveness, poor feeding, persistent alterations of muscle tone, or weight loss greater that 10% to 12% of birth weight.

Record details of resuscitation procedures and results as part of a permanent document for the child.
Jaundice

Neonatal jaundice is extremely common. Physiologic jaundice, the most frequent form of neonatal jaundice, is due to immaturity involving bilirubin metabolism in the liver combined with certain features in the newborn’s intestinal function (delayed intestinal transit, enhanced intestinal bilirubin reabsorption causing overload of the enterohepatic circuit). It may also relate to the newborn’s feeding. Jaundice associated with breastfeeding is another form of usually benign neonatal jaundice that can prolong physiologic jaundice. It is interesting to note that indirect bilirubin (the one that accumulates in physiologic jaundice) is a powerful antioxidant, so during the neonatal period, when the infant is exposed to oxidative stress, moderate levels of bilirubin may be a protective factor.

Assessment of the newborn with jaundice

Information gathered when assessing an infant with jaundice must include age, gestational age, birth weight, current weight, onset and duration of the jaundice, characteristics of the stools (quantity and color), and urine color. Newborns with pathologic perinatal history or a family history of another newborn with significant jaundice are at higher risk of developing severe jaundice. In addition, jaundice that appears within the first 24 hours after birth or persists for more than 10 days should be assumed to be severe, unless the opposite is proven. (Breastfeeding jaundice is a diagnosis made when no other cause has been found.)

On physical examination, danger signs of severity in an infant with jaundice include: poor suck, lethar-
Jaundice that appears within the first 24 hours after birth or persists for more than 10 days should be assumed to be severe, unless the opposite is proven.

A variety of hematologic, metabolic and infectious diseases that require early recognition and treatment can present with hyperbilirubinemia.

Jaundice extends in a cephalocaudal direction with increasing blood levels (Figure 7).

Based on the data gathered through history and physical examination, IMCI classifies jaundice and defines the corresponding treatment (Table 3).

**FIGURE 7. Estimates of bilirubin blood levels according to skin involvement**

<table>
<thead>
<tr>
<th>ASK</th>
<th>EXAMINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>How old is the child?</td>
<td><strong>Degree of jaundice</strong></td>
</tr>
<tr>
<td>What was his/her birth weight?</td>
<td>1. Only in the face</td>
</tr>
<tr>
<td>Since when is he/she yellow?</td>
<td>2. Up to the navel</td>
</tr>
<tr>
<td>Has he/she been passing stools?</td>
<td>3. Up to the knees</td>
</tr>
<tr>
<td>What color are the stools?</td>
<td>4. Up to the ankles</td>
</tr>
<tr>
<td>What color is the urine?</td>
<td>5. Palms/ soles</td>
</tr>
<tr>
<td>Is there a family history of significant neonatal jaundice?</td>
<td><strong>State of consciousness</strong></td>
</tr>
<tr>
<td></td>
<td>Lethargic, irritable, normal</td>
</tr>
</tbody>
</table>

**Assess:**
- Current weight

**Estimate of indirect bilirubin, according to compromised zone**
- Zone 1 = 6 mg/dL
- Zone 2 = 9-12 mg/dL
- Zone 3 = 12-15 mg/dL
- Zone 4 = >15 mg/dL
- Zone 5 = >18 mg/dL

Table 3. Classification of jaundice

<table>
<thead>
<tr>
<th>Signs</th>
<th>Classify as</th>
<th>Treatment</th>
</tr>
</thead>
</table>
| **(RED)** | Severe jaundice | **(RED)** Continue breastfeeding the infant  
• Refer URGENTLY to hospital, observing the guidelines for stabilization and transportation  
• If transportation is needed, counsel the mother to keep the newborn warm during the trip  |
| **(YELLOW)** | Moderate jaundice | **(YELLOW)** Counsel the mother to  
• Continue breastfeeding the infant and keep him/her warm  
• Specify signs of alarm and schedule a control visit in 24 hours  |
| **(YELLOW)** | Mild jaundice | **(YELLOW)** Counsel the mother to  
• Continue breastfeeding and keep the infant warm  
• Specify signs of alarm and schedule a control visit in 48 hours  |
| **(GREEN)** | No jaundice | **(GREEN)** Counsel the mother to  
• Continue breastfeeding the infant  
• Check vaccination  
• Teach the mother how to care for the infant at home  
• Specify danger signs  
• Schedule a control visit in the clinics for healthy children  |

SUMMARY

When treating newborns, good hand hygiene must be observed, and babies must be protected from contamination.

If gestation is not full-term, breathing is not vigorous, or muscle tone is poor, the first step is to ensure thermal protection and dry the infant thoroughly; next, position the head, clear the airway as necessary, and stimulate the breathing child. Evaluate breathing. If apnea, gasping, or inadequate breathing is observed, give positive-pressure ventilation and mobilize additional resuscitation team members. The child is evaluated again after 1 minute of positive-pressure ventilation and steps to improve ventilation (if necessary). If apneic, support is continued. If heart rate is <60 beats per minute, then cardiac compressions are added. If heart rate is >60 beats per minute on reevaluation, cardiac compressions are discontinued. On further evaluation, if heart rate is >100 beats per minute and spontaneous respirations are adequate, positive-pressure ventilation is discontinued.

Jaundice can be associated with severe pathologies and can lead to irreversible consequences. Observe closely patients with jaundice and evaluate them over subsequent hours and days.

Communication with and emotional support for the mother is of high priority. Mothers and babies should be kept together, if at all possible. Infants with ongoing problems or high-risk conditions should be referred to a higher level of care as appropriate.

SUGGESTED READING


Case resolution

In this case, several risk factors are associated with the need for neonatal resuscitation: patient’s age, inadequate prenatal care, maternal hypertension, and alterations in fetal cardiac frequency. A newborn exhibiting these risk factors is likely to need advanced resuscitation procedures. Ideally, refer the patient to a high-complexity mother-child care center. If that is not possible, it would be preferable to rely upon trained personnel and adequate equipment for an advanced resuscitation. It would be important to transport the child to a neonatal specialized center immediately after initial resuscitation for further care.
MODULE REVIEW

SECTION I- DELIVERY AND IMMEDIATE NEONATAL CARE

1. What are the key steps for a successful resuscitation?
2. What equipment and supplies are needed to perform neonatal resuscitation?
3. What maternal, obstetric, and fetal (or neonatal) factors indicate a high probability of needing advanced neonatal resuscitation?
4. What are the steps in initial resuscitation (reception) of the newborn?
5. What are the indications for oxygen administration and how should it be administered?
6. What signs are used to gauge the need for advanced neonatal resuscitation?
7. When and how should assisted respiration (ventilation) be administered to the newborn?
8. When and how should chest compressions be performed during neonatal resuscitation?
9. When and for how long should resuscitation procedures be performed?
10. Under what circumstances is neonatal resuscitation contraindicated?
11. What elements are necessary to assess and treat the infant with neonatal jaundice?

SECTION II- JAUNDICE

1. What signs should be assessed to determine the intensity and severity of jaundice?
2. How is bilirubin blood level estimated according to the extent of cutaneous jaundice?
3. What treatment corresponds to severe, moderate, and mild jaundice?
M O D U L E  8

Nutrition and Malnutrition

Teresa Kemmer | Clifton Yu
Andrew J. Bauer | Julia A. Lynch
INTRODUCTION

Providing adequate food to meet the nutritional needs of growing children is critical to prevent an increase in malnutrition prevalence, which would lead to excess mortality during the recovery phase of a disaster. Nutritional status directly impacts the vulnerability for and the severity of infectious diseases that affect children in emergency settings. Previously malnourished children are particularly vulnerable, as they cannot develop the protective compensatory mechanisms that allow healthy individuals to survive during periods of food deprivation. Therefore, after disasters those children will decompensate unless given immediate nutritional support. On the other hand, good nutritional status promotes wound healing and improves the postnatal outcomes in both mothers and babies. In disaster situations, it is crucial to provide adequate food to prevent the complications associated with malnutrition. According to the World Health Organization (WHO), “food security exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences, and to maintain an active and healthy life.”

Doctors in the local community are an invaluable source of information regarding the pre-disaster nutritional status of the pediatric population. Their involvement in nutritional assessments and food resource planning is essential. During an assessment, recognize that large
variations in baseline pediatric nutritional status can be found in a particular region. In addition, a paradoxical association of malnutrition and obesity can be found within the same household, especially in developing countries and in low-income groups. Micronutrient deficiencies, most importantly iron deficiency anemia, can be identified even in areas where the overall nutritional status is good.
NUTRITIONAL STATUS ASSESSMENT

OBJECTIVES

- Recognize the importance of assessing the nutritional status of the pediatric population affected by a disaster.
- Identify the vulnerable population groups in these situations.
- Know and use the different methods for anthropometric assessment of the pediatric population.

Initial assessment

The initial assessment of the nutritional status and food resources of a population affected by a disaster is part of the overall emergency needs assessment (Box 1). Obtain all available information regarding the pre-disaster prevalence of macro- and micronutrient deficiencies in the community. Information from public health authorities, health care professionals, and other health workers in the local community is critical for that purpose. Also, identify any nutrition programs active in the community before the disaster. This information helps to identify nutritionally vulnerable groups (Box 2). Finally, determine

CASE 1

You are member of a medical team delivering health care in a small town that has suffered a serious flood. It is necessary to establish the nutritional needs of the affected population.

- **What are the first steps in such evaluation?**

The assessment of the nutritional status of a population affected by a disaster is an ongoing process. It begins during the rescue phase with an initial rapid assessment and should continue as attempts are made to efficiently and equitably provide adequate nutrition resources to the affected population. The information gathered through this assessment is needed to use available resources more rationally during both the initial and the recovery phases of a disaster.
the quantity and quality of food stores readily available to the affected population. The data obtained through the initial assessment, together with accurate demographic data from the affected population, are needed to design and implement an adequate food response following a disaster.

**Assessment during the recovery phase**
In the recovery phase, as more outside resources become available and the local community becomes more organized, one of the goals is the development of programs to guarantee that available food resources will be targeted efficiently and effectively to populations in need. This requires the systematic assessment of the nutritional status of the population. **Box 1 outlines the basic components of ongoing recovery phase nutritional assessments.** These measures should be continued until adequate nutrition resources are appropriately and efficiently distributed.

**Anthropometric assessment in the pediatric population**
Anthropometric methods provide information regarding the height, weight, and proportions of a person. These data are used, particularly in children, to assess an individual’s nutritional status. Interpretation of anthropometric data requires the com-

---

### BOX 1. Assessment of the nutritional status and resources of the population affected by a disaster

<table>
<thead>
<tr>
<th><strong>Initial assessment</strong></th>
<th><strong>Assessment during the recovery phase</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Determine malnutrition and micronutrient deficiency prevalences before the disaster</td>
<td>• Determine the quality and security of available nutritional resources for the affected population, particularly for vulnerable groups</td>
</tr>
<tr>
<td>• Identify nutrition programs active in the community before the disaster</td>
<td>• Determine the current prevalence of malnutrition and micronutrient deficiencies</td>
</tr>
<tr>
<td>• Identify nutritionally vulnerable groups</td>
<td>• Do periodic reassessments until adequate nutrition resources are sustainable</td>
</tr>
<tr>
<td>• Determine the quantity and quality of available food storages readily available to the affected population</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of the individual’s measurements to standards for the appropriate population. When anthropometrics are systematically collected in a population, it is possible to characterize the community’s overall nutritional status. Generally the data from children under 5 years of age reflect the status of the community. In disaster situations, such data help to determine the global nutritional needs for all the affected population and how resources should be efficiently allocated.

**Anthropometric indexes**

**Box 3** shows the anthropometric indexes most commonly used in the assessment of children.

**Weight-for-age index (W/A)**
The W/A index represents the weight of a child in relation to his or her age. This is the index used by the Integrated Management of Childhood Illness (IMCI) program to assess the nutritional status of children (particularly those under 1 year of age). Consider the presence of dehydration and edema, which alter the weight when determining the index. A precision scale is required for weight measurement.

**Weight-for-height index (W/H)**
The W/H index represents the weight of a child in relation to the height. It reflects the current nutritional status of the child and is the index used to diagnose acute (wasting) or subacute malnutrition, where height has not been affected. In disaster situations, the W/H index is the most appropriate measurement to evaluate the nutritional status of the affected population. It also requires a precision scale and a measuring board or tape; it is also affected by dehydration and edema.

**Height-for-age (H/A) index**
The H/A index represents the height of a child in relation to his or her age. This

**Box 2. Vulnerable groups in a disaster situation**

- Children under 5 years of age
- Children taken away from their family or community
- Pregnant or lactating women
- Families living in a household headed by a woman
- Physically or emotionally disabled persons
- People with chronic diseases
- Elderly people

**Box 3. Anthropometric indexes most frequently used in children**

- Weight-for-age
- Weight-for-height
- Height-for-age
- Mid-upper arm circumference
- Body mass index
index basically reflects the nutritional history, since children with chronic malnutrition—whether primary or secondary to an underlying chronic disease—will experience stunted growth. Height, however, is also strongly determined by genetic factors.

**Mid-upper arm circumference (MUAC)**
The MUAC gives a measure of the amount of fat and muscle in the upper arm. It is measured with a standard tape on the left arm, midpoint between the shoulder and the tip of the elbow. It is used in children 6 months to 5 years of age to screen large numbers of children for malnutrition. The equipment required is minimal. Since MUAC is a screening tool, refer individuals identified as malnourished for further assessment to confirm the diagnosis. While universal cut-off points for interpreting MUAC do not exist, in clinical practice, a MUAC of <110 mm has been shown to be predictive of severe malnutrition.

**Body mass index (BMI)**
BMI is the weight in kilograms divided by the height in meters, squared (weight in kg/[height in m]²). BMI reference tables are now available to be used in children and adolescents from 2 to 20 years old. As an index, BMI does not reflect small changes in weight that may be clinically relevant, and it is also affected by dehydration and edema. Cut-off values for BMI percentiles in children and adolescents are as follows:

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Range</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5th</td>
<td></td>
<td>Underweight</td>
</tr>
<tr>
<td>5th-85th</td>
<td></td>
<td>Within normal limits</td>
</tr>
<tr>
<td>85th-95th</td>
<td></td>
<td>At risk for overweight</td>
</tr>
<tr>
<td>&gt;95th</td>
<td></td>
<td>Overweight</td>
</tr>
</tbody>
</table>

**Percentiles**
Percentiles are determined by the position of an individual’s measure in the reference values in terms of the percentage of values exceeded or equaled. In the reference population, the weight for a given height shows a normal distribution. The 50th percentile is the weight that divides the reference population into two equal parts: with 50% above and 50% below. As an example, if 25% of the reference population weighs less than the child being examined, the child is in the 25th percentile.

A review of how these anthropometric tools may be used to determine nutritional status of an individual is shown in Table 1.

**Reference tables**
Regardless of the anthropometric parameter used, the measurements obtained are useful only if the standards with which they are compared truly reflect the population that is being evaluated. Many countries have developed their own growth tables and graphics reflecting the standard for their own population, but many regions have not been included. WHO recently published new growth reference charts developed with data...
gathered from Brazil, Ghana, India, Norway, Oman, and the United States. The children selected were exclusively breastfed, healthy, and had their basic needs met. There is solid evidence to suggest that all children up to age 5 years grow very similarly when their physiological needs are adequately met, so these reference charts are valid for evaluating growth in children all over the world. More information can be found at http://www.who.int/childgrowth/en/
CLINICAL FEATURES OF MALNUTRITION

OBJECTIVES

- Identify through physical examination the main clinical findings of protein-energy malnutrition and those indicating severe malnutrition.
- Recognize the particular features and the clinical and pathophysiologic differences between marasmus and kwashiorkor.
- Describe the pathophysiology of the refeeding syndrome.

Healthy, well-nourished persons have some protection from acute malnutrition, because they have adequate stores of glycogen, protein reserves, and calories stored as fat. During the first 3 days without food, glycogen stores in the liver and muscle are depleted, and the liver attempts to maintain blood sugar levels by converting mobilized amino acids into glucose (gluconeogenesis). At the same time, the breakdown of fat (lipolysis) leads to the formation of an alternate fuel source, ketone bodies, allowing for short-term survival. However, individuals who are malnourished at the onset of a disaster are incapable of activating these protective mechanisms and thus face greater risk of acute nutritional decompensation.

Types of protein-energy malnutrition

Protein-energy malnutrition (PEM) is a general term describing a state of deficiency involving multiple nutrients. Usually malnutrition in children results from a combination of energy and protein deficiency, often with associated micronutrient deficiency. The pathophysiology of severe PEM is very complex, affecting the cellular function of many organ systems, including heart and bowel. In the heart, redistribution of muscle proteins increases the risk for cardiovascular collapse, and damage to the intestinal villi leads to malabsorption. The edema associated with malnutrition results from a combination of hypoalbuminemia and deficiencies in copper, zinc, selenium, and vitamins A, E, and C.

There are two clinical presentations of severe PEM: marasmus and kwashiorkor. Marasmus is the most common form of PEM and is caused by deprivation of both energy/calories and protein that leads to weight loss of more than 20% of initial body weight. It is characterized by profound wasting, fatigue, apathy, and irritability. A person of normal weight (10% to 12% body fat) would develop marasmus after approximately 60 days of total starvation. Marasmus is most common in infants under 1 year of age, and these children maintain their hunger despite appearing irritable.

Kwashiorkor results from inadequate protein intake and usually occurs when a pre-
viously malnourished patient is exposed to the catabolic stress of infection (measles, tuberculosis, pertussis, and others), diarrhea, or trauma. In Latin America, kwashiorkor is estimated to occur in only 2% of malnourished individuals, although in some regions in the world, such as Africa, this proportion is much higher, up to 30%. It is more commonly found in children 1 to 3 years of age and is more prevalent in regions where the majority of nutrition is obtained from starchy vegetables that may be contaminated with aflatoxin (a fungal toxin that commonly attacks plants in wet regions). Kwashiorkor is characterized by abdominal distension, peripheral edema, flaking skin lesions, hair changes, including decoloration, and hepatomegaly. Children with kwashiorkor are often anorexic, which poses additional challenges to their management. A subset of these children may present with marasmic kwashiorkor, typically with edema, significant subcutaneous fat and muscle wasting, stunting, and mild hepatomegaly. Children with marasmic kwashiorkor show high mortality rates; thus, highly cautious rehydration and refeeding are critical.

**The refeeding syndrome**

Complications of refeeding syndrome include:

- Hypothermia
- Hypoglycemia
- Hypokalemia
- Hypophosphatemia

During starvation, there is a redistribution of proteins, fluids, and electrolytes, as the body tries to adapt to the state of malnutrition. Acidosis, associated with the catabolic state, leads to a potassium shift from the intracellular compartment into the blood. Elevated aldosterone levels result in total body potassium depletion (similar to that found in diabetic ketoacidosis). Reintroduction of fluids and carbohydrates, via oral, enteral, or parenteral routes, produces a sudden shift back to glucose as the predominant fuel source, leading to increased demand for phosphorylated intermediates of glucose metabolism, increased insulin production, and the shift of potassium back into the cells associated with the resolution of the acidosis. This results in hypoglycemia, hypokalemia, and hypophosphatemia. If the reintroduction of nutrients and fluids is too aggressive, these electrolyte changes may result in circulatory overload with cardiorespiratory decompensation due to the cardiac and respiratory musculature abnormalities associated with malnutrition.

Therefore, it is necessary to reassess the patient repeatedly and develop an appropriate management plan to avoid these complications. To avoid cardiovascular overload, it is recommended to only use intravenous fluids in the treatment of shock. Give additional phosphate, potassium, magnesium, and thiamin, as well as a continuous supply of glucose to compensate for rapid shifts between intracellular and extracellular compartments (see Appendix for suggested recommendations). When refeeding is initiated, it should be performed in phases (see Section IV). Consider treating associated infections and likely micronutrient deficiencies.
MICRONUTRIENT DEFICIENCIES

OBJECTIVES

• List specific micronutrient deficiencies, their risk factors, and clinical signs.
• Describe the epidemiology, pathophysiology, and clinical presentation of vitamin A, iron, and zinc deficiencies.
• Describe the general management for micronutrient deficiency prevention and treatment in acute emergency settings.

CASE 2

You are providing pediatric care to a population that has been displaced after a flood. A mother comes to the health care unit with her 4-month-old son, who was born after 35 weeks of gestation and is exclusively breastfed. Physical findings are normal. The weight and height are at the 50th percentile (age corrected for gestational age).

• What are your recommendations regarding iron intake?

Different dietary insufficiencies may lead to specific micronutrient deficiencies. Some of these have typical clinical manifestations.

Specific dietary risk factors for important micronutrient deficiencies and possible solutions are outlined in Table 2. Table 3 summarizes the classic physical findings associated with significant micronutrient deficiencies.

Vitamin A deficiency

Vitamin A is critical for vision and epithelial integrity. In addition, vitamin A deficiency (VAD) is associated with disorders in hematopoiesis and immune function. Thus, treatment of such deficiency has beneficial effects for patients with anemia and improves the outcome of infections, particularly measles. VAD is associated with diets lacking fresh fruits and vegetables, as well as animal products, dairy products, and eggs. VAD has a dramatic global impact on health, with approximately 127 million preschool-age children and 20 million women affected worldwide. It has been estimated that unidentified VAD results in about 2 million deaths in young infants, particularly due to excess morbidity and mortality associated with measles (see Module 5).

VAD is the most common preventable cause of childhood blindness in the world. It is also the most frequent deficiency syndrome among displaced populations.

The clinical features of VAD involving the ocular system are known as xerophthalmia. The stages of xerophthalmia include night blindness, conjunctival xerosis, and keratomalacia. Night blindness is the most prevalent and earliest stage of xerophthalmia resulting from the impact of VAD on the retinal epithelium. Since this symptom may precede any apparent physical findings, its occurrence must be assessed through a careful history.
### TABLE 2. Micronutrient deficiencies: risk factors and possible solutions

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Dietary Risk Factor</th>
<th>Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niacin (pellagra)</td>
<td>Maize-based diet</td>
<td>Foods rich in proteins and whole grain cereals</td>
</tr>
<tr>
<td>Thiamin (beri-beri)</td>
<td>Polished rice-based diet</td>
<td>Whole or parboiled rice, legumes, beef, fish, eggs, milk; fortified cereal blends</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>Diet with not enough fresh fruits</td>
<td>Dark orange fruits and vegetables, yellow corn, fortified cereal, animal products, dark green leafy vegetables, vitamin A supplements</td>
</tr>
<tr>
<td>Vitamin C (scurvy)</td>
<td>Diet with not enough fresh fruits and extremely low fat intake</td>
<td>Fresh raw fruits/vegetables, liver, fresh animal milk</td>
</tr>
<tr>
<td>Iron (ferropenic anemia)</td>
<td>Diet lacking animal products</td>
<td>Animal products (liver, meat); dried fruits; consumption of vitamin C with meals; iron/folate supplements or fortified cereal blends. From ages 6-24 months on, nearly all iron will need to come from supplementary foods</td>
</tr>
<tr>
<td>Zinc</td>
<td>Diet lacking animal products</td>
<td>Animal products (liver, meat); fortified cereal, peanuts. From ages 6-24 months on, nearly all zinc intake is provided by supplementary foods</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>Diet lacking animal products</td>
<td>Animal products (liver, eggs, fish); milk, leafy green vegetables. From ages 6-24 months on, nearly all riboflavin intake is provided by supplementary foods</td>
</tr>
<tr>
<td>Vitamin D (rickets)</td>
<td>Lack of exposure to sunlight</td>
<td>Fortified milk, liver, egg yolk</td>
</tr>
<tr>
<td>Calcium</td>
<td>Lack of milk; dark green leaves, or fish with bones</td>
<td>Milk, fish with bones (e.g., sardines), beans and green peas, dark green leaves, calcium carbonate (used in making tortillas)</td>
</tr>
</tbody>
</table>

Adapted from Savage, King, and Burgess, p. 430-431; and Médecins Sans Frontières, p. 27; Infant and Young Child Feeding in Emergencies; Nutrition Module for the Interaction Health Training Curriculum; Academy for Educational Development. 1997.
### TABLE 3. Physical findings commonly associated with micronutrient deficiencies

<table>
<thead>
<tr>
<th>Physical Signs</th>
<th>Possible Nutritional Deficiencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hair:</strong></td>
<td></td>
</tr>
<tr>
<td>Dry, dull, easily pluckable</td>
<td>Protein-energy malnutrition</td>
</tr>
<tr>
<td>Sparse, hair loss</td>
<td>Zinc, protein, biotin, essential fatty acids</td>
</tr>
<tr>
<td><strong>Eyes:</strong></td>
<td></td>
</tr>
<tr>
<td>Pale sclera</td>
<td>Iron, vitamin B6, B12</td>
</tr>
<tr>
<td>Bitot’s spots; night blindness</td>
<td>Vitamin A</td>
</tr>
<tr>
<td><strong>Mouth:</strong></td>
<td></td>
</tr>
<tr>
<td>Red, swollen lips</td>
<td>Niacin, riboflavin, iron and/or vitamin B6, B12, Niacin, riboflavin</td>
</tr>
<tr>
<td>Angular stomatitis (cracks at sides of mouth)</td>
<td>Niacin, riboflavin, iron and/or vitamin B6, B12, Niacin, riboflavin</td>
</tr>
<tr>
<td>Cheilosis</td>
<td>Niacin, riboflavin</td>
</tr>
<tr>
<td><strong>Gums:</strong> Swollen, bleeding, abnormally red</td>
<td>Vitamin C</td>
</tr>
<tr>
<td><strong>Tongue:</strong></td>
<td></td>
</tr>
<tr>
<td>Glossitis</td>
<td>Vitamin B complex*, iron</td>
</tr>
<tr>
<td>Dark red</td>
<td>Riboflavin</td>
</tr>
<tr>
<td>Pale</td>
<td>Iron</td>
</tr>
<tr>
<td><strong>Teeth:</strong></td>
<td></td>
</tr>
<tr>
<td>Dental caries</td>
<td>Fluoride, vitamin C</td>
</tr>
<tr>
<td><strong>Taste:</strong> Dysgeusia or hypogeusia</td>
<td>Zinc</td>
</tr>
<tr>
<td><strong>Skin:</strong></td>
<td></td>
</tr>
<tr>
<td>Loose</td>
<td>Calories</td>
</tr>
<tr>
<td>Lower extremity edema</td>
<td>Protein, thiamin</td>
</tr>
<tr>
<td>Pallor</td>
<td>Iron, folic acid, vitamin B12, biotin</td>
</tr>
<tr>
<td>Poor healing</td>
<td>Vitamin C, zinc, protein, calories</td>
</tr>
<tr>
<td>Reduced skin turgor (positive skin pinch)</td>
<td>Fluids, marasmus</td>
</tr>
<tr>
<td>Small, purplish spots</td>
<td>Vitamin C</td>
</tr>
<tr>
<td>Pellagra (pigmented keratotic scaling lesions)</td>
<td>Niacin</td>
</tr>
<tr>
<td>Follicular hyperkeratosis</td>
<td>Vitamin A and/or essential fatty acids</td>
</tr>
<tr>
<td>Ecchymosis</td>
<td>Vitamin K</td>
</tr>
<tr>
<td><strong>Nails:</strong></td>
<td></td>
</tr>
<tr>
<td>Brittle or ridged</td>
<td>Protein</td>
</tr>
<tr>
<td>Spoon-shaped</td>
<td>Iron</td>
</tr>
<tr>
<td><strong>Musculoskeletal:</strong></td>
<td></td>
</tr>
<tr>
<td>Muscle wasting</td>
<td>Protein, energy</td>
</tr>
<tr>
<td>Rickets, osteomalacia</td>
<td>Vitamin D, calcium</td>
</tr>
<tr>
<td><strong>Neurologic:</strong></td>
<td></td>
</tr>
<tr>
<td>Hyporeflexia</td>
<td>Thiamin</td>
</tr>
<tr>
<td>Muscle cramps</td>
<td>Chloride, sodium</td>
</tr>
<tr>
<td>Peripheral neuropathy</td>
<td>Vitamin B6</td>
</tr>
</tbody>
</table>

*Vitamin B complex = thiamin, riboflavin, niacin, vitamin B6, folic acid, vitamin B12, biotin, pantothenic acid.

Research by: Jennifer Wagoner, MS, RD, CNSD, of Roche Dietitians.
Conjunctival xerosis presents as a dry, nonwettable, rough or granular surface, which can be seen using a hand-light. More advanced xerosis is associated with Bitot's spots which are bubbly, foamy, or cheese-like patches visible on the conjunctival epithelium. Conjunctival xerosis may progress to ulceration or in the most advanced form to keratomalacia, its typical presentation being necrosis of the cornea.

**Supplementation**

A diet containing sufficient amounts of foods rich in vitamin A is enough to prevent hypovitaminosis. When adequate amounts of vitamin A are not available through dietary sources, consider supplementation. Vitamin A supplementation has been shown to reduce pre-school child mortality by 25% to 35%, and to virtually eliminate nutritional blindness in many low- and middle-income countries. In acute humanitarian emergencies, if an adequate diet was not available and a regular vitamin A supplementation program was not in place for the general population prior to the disaster, provide vitamin A supplementation to all children 6 months to 5 years of age at the first contact with the health care staff. A vitamin A supplementation program can be provided in conjunction with the immunization/measles vaccine campaign. Repeat this supplement every 3 to 6 months if an adequate supply of vitamin A cannot be provided through diet. In areas with a vitamin A supplementation program in place, maintain the distribution of the supplement every 3 to 6 months starting from the last time it was provided. Fortified foods with vitamin A and other essential micronutrients should be distributed during the recovery phase. Individuals with symptoms and signs of VAD should receive the recommended treatment. **Table 4** shows preventive and treatment doses of vitamin A.

<table>
<thead>
<tr>
<th>Age</th>
<th>Treatment*</th>
<th>Preventive Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 months</td>
<td>50,000 IU</td>
<td>50,000 IU every 4-6 months</td>
</tr>
<tr>
<td>6-12 months</td>
<td>100,000 IU</td>
<td>100,000 IU every 4-6 months</td>
</tr>
<tr>
<td>&gt;1 year</td>
<td>200,000 IU</td>
<td>200,000 IU every 4-6 months</td>
</tr>
<tr>
<td>Women</td>
<td>200,000 IU**</td>
<td>200,000 IU ≤ 8 weeks after delivery</td>
</tr>
</tbody>
</table>

* Treat all cases of xerophthalmia and measles with the same age-specific dosage the next day and again 1 to 4 weeks later.
** For women of reproductive age, give 200,000 IU only for corneal xerophthalmia; for ocular eye signs (night blindness or Bitot's spots), give 5,000-10,000 IU per day or ≤25,000 IU per week for ≥4 weeks.

Iron deficiency
Iron deficiency (ID) is the most common nutritional deficiency worldwide. In developing countries, most affected individuals are women and children. Risk factors for ID, in addition to a diet lacking animal products, include: pregnancy, prematurity, low birthweight, early umbilical cord clamping, rapid growth, cow’s milk feeding (intestinal microhemorrhages), reduced intestinal absorption of iron due to high phytate and phosphate intake (cola beverages), menstruation, and parasitic infections. ID is also the most frequent cause of anemia. The three major causes of anemia in the developing world are nutritional deficiencies, malaria, and intestinal parasites (hookworm). The prevalence of anemia has been used as a surrogate marker of ID prevalence in a certain population. It has been estimated that ID in a population is 2 to 3 times more prevalent than ID anemia (IDA).

Clinical findings associated with severe anemia include skin, mucus membranes, and nail beds pallor, as well as dyspnea or tachypnea at rest. Clinical examination is not a reliable method for diagnosing isolated iron deficiency or milder forms of anemia. If laboratory tests are available, the diagnosis of anemia can be documented with hemoglobin (Hb) or hematocrit determinations. Table 5 shows the age-specific cut-off values for Hb and hematocrit according to WHO guidelines. The reduction in tissue oxygen supply associated with anemia is responsible for the clinical manifestations and long-term consequences of iron deficiency. Anemia is associated with growth retardation, increased susceptibility to infections, and impaired cognitive and psychomotor development. Very severe anemia (Hb <5 g/mL) is associated with increased mortality. Iron therapy has been shown to reverse some of these effects, but long-term studies suggest that iron deficiency anemia in early childhood can lead to irreversible developmental damage.

Iron supplementation for prevention and treatment of anemia
Due to the high bioavailability (about 50%) of lactoferrin-linked iron in human milk, exclusive breastfeeding during the first 4 to

<table>
<thead>
<tr>
<th>Age or Group</th>
<th>Hb below (g/mL)</th>
<th>Htc below (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children 6 to 60 months</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Children 5-11 years</td>
<td>11.5</td>
<td>34</td>
</tr>
<tr>
<td>Children 12-13 years</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>Non-pregnant women</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Men</td>
<td>13</td>
<td>39</td>
</tr>
</tbody>
</table>

6 months guarantees an appropriate iron pool in healthy term infants. Preterm infants need early iron supplementation, because their iron pools at birth are insufficient. With the introduction of solids at 6 months of age, begin appropriate supplementary feeding including foods with highly bioavailable heme iron (see Table 8 on page 21). Iron absorption can be enhanced by adding animal protein to the food. Adequate intake of vitamin C and reduction of iron absorption suppressors in the diet also help to increase iron bioavailability. Adequate dietary intake of folic acid is also important.

---

**TABLE 6. Iron supplements to prevent anemia**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Dosage (daily)</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of anemia in children 6-12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;40%</td>
<td>12.5 mg iron plus 50 µg folic acid</td>
<td>From 6-12 months of age</td>
</tr>
<tr>
<td>&gt;40%</td>
<td>12.5 mg iron plus 50 µg folic acid</td>
<td>From 6-24 months of age</td>
</tr>
<tr>
<td>Children 2-5 years</td>
<td>20-30 mg iron plus 50-150 µg folic acid</td>
<td></td>
</tr>
<tr>
<td>Children 6-11 years</td>
<td>30-60 mg iron plus 50-150 µg folic acid</td>
<td></td>
</tr>
<tr>
<td>Adolescents and adults</td>
<td>60 mg iron (girls and women of reproductive age should also receive 400 µg folic acid)</td>
<td>2-4 month course of daily dosing or weekly supplementation for as long as they are at risk</td>
</tr>
<tr>
<td>Prevalence of anemia in pregnant women in the area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;40%</td>
<td>60 mg iron + 400 µg folic acid&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6 months in pregnancy (or if started late, extend to postnatal period for a total of 6 months)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>&gt;40%</td>
<td>60 mg iron + 400 µg folic acid&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6 months in pregnancy plus continuing to 3 months postpartum (or a total of 9 months)</td>
</tr>
</tbody>
</table>

Notes:
1. Iron dosage for children 2-5 years of age is based on 2 mg iron/kg body weight/day.
2. Research is ongoing to determine the most cost-effective dosing regimen for iron supplementation in these age groups in different contexts. The efficacy of once- or twice-weekly supplementation in these groups appears promising, and the operational efficiency of intermittent dosing regimens is being evaluated. While policy recommendations are being formulated, program planners in their communities should adopt the dosing regimen believed to be most feasible and sustainable in their communities.
   <sup>a</sup> Where iron supplements containing 400 µg of folic acid are not available, an iron supplement with a lower level of folic acid may be used.
   <sup>b</sup> If 6 months duration cannot be achieved, increase the dose to 120 mg iron during pregnancy.

since IDA is often associated with folate deficiency (see Table 8 in page 21).

Iron supplementation programs have been effective in preventing ID. Preventive iron supplementation beginning at 6 months of age is encouraged and should be made available to those at risk for ID, since risks associated with ID at this age are highly significant. Recommendations for iron combined with folic acid supplementation for the prevention of ID are found in Table 6; severe anemia management is outlined in Table 7.

**Public Health Measures:** To ensure adequate iron status, in addition to providing adequate amounts of dietary iron, it is essential to implement public health programs to control hookworm and other micronutrient deficiencies. In selected areas with endemic infections, antihelmintic medication should also be routinely given to all individuals over the age of 2 years, since helminthic infections, including hookworm infections, can have significant negative impact on anemia status. Various medications are available for the treatment of helminthic infections. For example: mebendazole (100 mg tablets) is used for routine therapy in hookworm infection in adults and children over 2 years: 1 tablet morning and evening for 3 days. For global therapy in a community, a single 200 mg dose is provided to all individuals over 2 years.

**Zinc deficiency**
The exact prevalence of zinc deficiency worldwide is not known, but is estimated to be similar to that of ID, which makes it an underrecognized public health problem. Zinc is essential for mammalian cell life, function, growth, differentiation, and replication. Yet it is one of the least apparent micronutrient deficiencies. Despite its importance, zinc deficiency remains an understudied public health issue.
immune function of individuals, as a constituent of more than 200 enzymes and transcription proteins that modulate cell differentiation, nucleic acid synthesis, and the metabolism of proteins, lipids, and carbohydrates.

Zinc supplementation in children with deficiency has been shown to reduce the incidence and prevalence of diarrhea and severe lower respiratory tract infections. Supplementation with zinc also reduces the frequency of malaria infections.

Decreased growth velocity or stunted growth is a consistent and early outcome of even mild zinc deficiency in infants, children, and adolescents. Box 4 shows the multiple clinical features of zinc deficiency.

Risk factors for zinc deficiency include: insufficient dietary intake (low-protein diet); high phytate and/or fiber content in the diet; diarrhea and other malabsorption syndromes; intestinal parasitosis; hot and humid weather; and no breast-feeding.

Young children’s dietary intake of zinc appears to be inadequate in many developing countries and it has been estimated that 80% of women globally and 100% of women in developing countries, have zinc intakes inadequate to meet pregnancy needs. Food sources high in zinc are listed in Table 8 (page 21).

Promotion of exclusive breastfeeding for the first 6 months prevents zinc deficiency in infants. Fruits and other vegetables are not good sources of zinc, because zinc in vegetable proteins is poorly bioavailable, in contrast to zinc associated with animal proteins. It is also important to reduce the phytic acid content of the diet because it suppresses zinc absorption.

Supplementation offers the most immediate approach to improving zinc status, and fortification should be the primary long-term public health initiative to prevent deficiencies of this micronutrient. Box 5 shows zinc daily recommended intakes.

In the management of diarrhea, some authors recommend the supplementation with zinc in combination with oral rehydration solution.

**General management for micronutrient deficiencies in disasters**

In disaster situations, prevention of protein-energy malnutrition should be the primary target when determining ration composition. However, adequate provision of micronutrients is also essential in order to reduce the morbidity and mortality associated with these deficiencies. Address measures directed at that goal during the early stages of the recovery phase.

Perform an initial assessment of the population affected by the disaster and devise a management plan to meet the identified needs. The plan should include the following elements:

1. Assess pre-disaster prevalence of micronutrient deficiencies.
2. Assess pre-disaster food sources to identify possible pre-existing deficiencies.
3. Determine current deficiency risks based on post-disaster food sources.
Plan and develop such strategies at national and/or local level, and design them taking into account type of disaster/emergency, local conditions, populations at risk, severity of the problem, etiology, resources, and social and cultural issues.

Some possible measures include:

a. Fortification of general rations
b. Supplementation for at-risk individuals
c. Variety of diet
d. Community-focused nutrition education
e. Food ration monitoring
f. Improved sanitation

4. Ensure health workers ability to recognize and treat overt deficiencies.
5. Establish a method for periodic assessment of the prevalence of deficiencies, with emphasis on the surveillance of those associated with higher risk.
6. Develop feasible, community-based strategies to reduce the risk of micronutrient deficiencies.

**BOX 4. Clinical manifestations of zinc deficiency**

- Decreased growth velocity
- Peri-orificial and acral skin lesions
  - Glossitis
  - Alopecia
  - Nail dystrophy
- Delayed sexual development
- Erectile dysfunction
- Behavioral abnormalities
- Photophobia and impaired ocular adaptation to darkness
- Delayed wound, burn, and pressure ulcer healing
- Impaired or loss of taste
- Lowbirth weight and prematurity

**BOX 5. Zinc daily recommended intake**

- Infants: 5 mg
- Young children: 10 mg
- Women: 12 mg
- Doses in diarrhea: 20 mg/day, 10-14 days
### TABLE 8. Food sources high in selected vitamins and minerals

<table>
<thead>
<tr>
<th>Vitamin or mineral</th>
<th>Food sources, absorption inhibitors, and enhancers</th>
</tr>
</thead>
</table>
| **Vitamin A**     | Plant foods high in vitamin A (carotenoids): Greens (spinach, chicory, endive, collard, watercress, mustard, beet, turnip, broccoli), carrot, pumpkin, squash (winter acorn, hubbard and butternut), peas, red hot chili and sweet peppers, sweet potato, mango, papaya, apricot, asparagus, tomato, prune, plum  
Preformed vitamin A from animal foods is found in mother’s milk, liver, fish-liver oils, butter, cheese, milk fat, eggs, and vitamin A-fortified foods |
| **Iron**          | Heme iron: Meat, fish, and poultry  
Non-heme iron: Eggs, dried beans, green leafy vegetables, whole grains, legumes, seeds, dried fruits, and iron-fortified foods  
Absorption enhancers: Foods containing vitamin C, other organic acids, and animal tissue  
Absorption inhibitors: High phytate foods, such as maize, legumes, whole wheat, brown rice, and unmilled sorghum. Foods high in tannins (polyphenol) such as tea and coffee |
| **Folic acid**    | Green leafy vegetables, such as spinach and romaine lettuce; pinto, kidney, and navy beans; peas; chicken giblets; liver; strawberries; citrus fruits and juices; peanuts; whole grain breads, rolls, crackers, and cereals; and fortified cereals, pasta, rice, and flours |
| **Niacin and tryptophan** | Niacin: Meat, poultry, fish, liver, peanuts (groundnuts), legumes, and yeast  
Increases the bioavailability of niacin: Alkali processing  
Tryptophan (metabolizes into niacin): Milk and eggs |
| **Thiamin**       | Parboiled rice, whole grain flour and cereals, pulses, nuts, wheat germ, yeast extract, pork, liver, kidney, and vegetables, such as peas, asparagus, and okra  
Absorption enhancers: Foods containing vitamin C  
Absorption inhibitors: Tea, coffee, alcohol and folate deficiency |
| **Vitamin C** (ascorbic acid) | All citrus juices and fruits, such as orange, lemon, lime, and grapefruit; cabbage; tomato; berries; potatoes with skins; green and red peppers; broccoli; spinach; and brussels sprouts |
| **Vitamin D**     | Dairy products, fortified milk, fortified cereals, eggs, oily fish, such as herring, salmon, or tuna, and fish liver oils |
### Micronutrient Deficiencies

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodine</td>
<td>Fortified foods, such as iodized salt, are required in areas of the world that have an inadequate amount of iodine in the soil</td>
</tr>
<tr>
<td>Zinc</td>
<td>Red meat, liver and other viscera, poultry, lamb, shellfish, eggs, and milk are excellent sources of bioavailable zinc. Peanuts, peanut butter, and legumes are good sources</td>
</tr>
<tr>
<td>Vitamin B6 (pyridoxine)</td>
<td>Milk, whole grain cereals, bread, liver, avocados, spinach, green beans, banana, fish, poultry, meat, nuts, potatoes, green leafy vegetables</td>
</tr>
</tbody>
</table>
IMCI STRATEGY FOR NUTRITIONAL STATUS ASSESSMENT

OBJECTIVES

- Assess and classify the nutritional status of children according to the Integrated Management of Childhood Illness (IMCI) guidelines and determine the appropriate management strategy.
- Identify anemia using IMCI tools and recommend the appropriate management strategy.

Assessing the nutritional status of children, including the presence of anemia, is an important step in IMCI strategy. As with other conditions, IMCI guidelines classify children according to the severity of the condition and recommend an adequate level of management.

Severe malnutrition or anemia

Severe malnutrition or anemia is based on the presence of specific clinical signs (Table 9). Some modified versions of the IMCI strategy include the evaluation of weight for age (W/A) in infants younger than 1 year or weight for height (W/H) in children from 1 to 4 years of age, using local reference charts for comparison.

CASE 3

You receive at a refugee camp clinic a 9-month-old boy whose weight is 5 kg and height 68 cm (26.8 in). He has no signs of severe illness, fever, cough, difficult breathing, or upper respiratory disease.

- What is your next step using the IMCI guidelines?

<table>
<thead>
<tr>
<th>TABLE 9. Classification of severe malnutrition and/or anemia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assess Signs</strong></td>
</tr>
<tr>
<td><em>(RED)</em></td>
</tr>
<tr>
<td>• Edema in both feet</td>
</tr>
<tr>
<td>• Signs of severe emaciation</td>
</tr>
<tr>
<td>• Intense pallor of the palms</td>
</tr>
<tr>
<td>• &lt;1 y: very low weight for age (40% deficit or more)</td>
</tr>
<tr>
<td>• 1-4 y: weight/height ratio &lt;70%</td>
</tr>
</tbody>
</table>
**Moderate malnutrition or anemia**

Classic IMCI strategy classifies children with low weight for age and no other sign of severe malnutrition in the moderate malnutrition category regardless of age. A distinction between moderate and mild malnutrition is not made. Modified versions of IMCI guidelines use the weight/height ratio for children from 1 to 4 years of age (Table 10) and allow a distinction between moderate and mild malnutrition, resulting in some


---

**TABLE 10. Classification of moderate and mild malnutrition and anemia**

<table>
<thead>
<tr>
<th>Assess Signs</th>
<th>Classify as</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(YELLOW)</strong></td>
<td>(YELLOW) Moderate malnutrition (Grade II) and/or anemia</td>
<td>(YELLOW) Refer to hospital if there is an associated disease</td>
</tr>
<tr>
<td>• &lt;1 years: low weight for age (deficit of 25%-40%)</td>
<td></td>
<td>• Assess the child’s feeding and counsel the mother according to section <em>Counselling the mother</em> (or according to national guidelines)*</td>
</tr>
<tr>
<td>• 1-4 years: weight to height ratio &lt;80%</td>
<td></td>
<td>• Schedule a follow-up visit after 7 days. (Perform active search if the mother doesn’t come)</td>
</tr>
<tr>
<td>• Mild pallor of palms</td>
<td></td>
<td>• Give iron to children &lt;2 years (therapeutic dose) (if possible, determine Hb and Htc)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Give oral antimalarial if there is high risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Give mebendazole (tinidazole) to children &gt;2 years if they have not received any dose during the past 6 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tell the mother when to come back immediately</td>
</tr>
</tbody>
</table>

| (YELLOW) | (YELLOW) Mild malnutrition (Grade I) | (YELLOW) |
| • <1 years: weight low for age (deficit 10%-25%) and/or weight for age under the 10th percentile | | |
| • 1-4 years: weight to height ratio less than 90% from average | | |
| | | |

changes in management, such as the recommended iron dose (treatment dose for moderate, and prophylactic for mild malnutrition). On the other hand, refer children classified in the moderate malnutrition group to a hospital for adequate assessment if there is any associated disease.

**Normal nutritional status**
Children with no signs of malnutrition or palmar pallor are considered to be in good nutritional status. The interventions will be limited to prevention and health control (Table 11).

For recommended iron dosages in different age groups, see Table 7 in Section III. Children receiving fortified milk after 6 months of age do not need iron supplementation, unless living in areas with very high prevalence of anemia.

### TABLE 11. Classification of normal nutritional status

<table>
<thead>
<tr>
<th>Assess Signs</th>
<th>Classify as</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(GREEN)</strong></td>
<td><strong>(GREEN)</strong></td>
<td><strong>(GREEN)</strong></td>
</tr>
<tr>
<td>• Normal weight for age or weight for height</td>
<td>No malnutrition or anemia</td>
<td>• Assess the child’s feeding and counsel the mother according to section <em>Counselling the mother</em> (or according to national guidelines)*</td>
</tr>
<tr>
<td>• No signs of malnutrition</td>
<td></td>
<td>• If there is any feeding problem, schedule control visit in 5 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Give iron to children 4-18 months (prophylactic dose)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tell the mother when to come back immediately</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Schedule a monitoring visit for healthy children according to national guidelines</td>
</tr>
</tbody>
</table>

Maternal hormone and neurotransmitter release during breastfeeding can help a mother to relax and attenuate stress and anguish caused by the disaster.

Breastfeeding
Breast milk is the ideal form of nutrition for all infants during the first 6 months of life, making the consumption of other food resources by this age group unnecessary. The World Health Organization (WHO) recommends that breastfeeding be continued until the child is at least 24 months old, progressively supplemented with appropriate complementary foods after 6 months of age. In emergency settings where food supplies are limited, human milk remains an invaluable source of critical nutrients, particularly proteins. Therefore, it is important to provide adequate nutrition to lactating mothers.

Breast milk protects the infant against acute respiratory infections and diarrhea, both causing significant morbidity and mortality among infants and younger children. Overcrowded conditions, and limited access to clean and adequate water supplies, and stool disposal systems significantly increase the risk for these diseases in disaster situations. There is a common misconception that maternal stress or malnourishment leads to an inability to breastfeed. In fact, maternal hormone and neurotransmitter release during breastfeeding can help a mother to relax and attenuate stress and anguish caused by the disaster. The quality and quantity of breast milk has been shown to be adequate in all but the most severe degrees of maternal malnutrition.

Introducing nonhuman milk or formula either to supplement or to complement breast milk, decreases maternal milk production to the point where it may compromise breast-feeding when a safe and sustainable supply of formula is no longer available.

Resources needed to safely feed a child non-human milk or formula, namely clean water, appropriate containers and methods for storage, and a safe and effective way to clean the containers or bottles, are

**OBJECTIVES**

- Recognize the importance of breastfeeding as well as its nutritional and logistic benefits in an emergency context.
- Describe the different feeding program options in disaster situations.
- Identify the phases of a therapeutic feeding program.
always scarce in an emergency setting, as is the continued availability of formula or milk itself.

Consider the careful and judicious use of breast milk substitutes in special circumstances, such as HIV-infected mothers, provided replacement feeding is feasible, affordable, sustainable, and safe. If these conditions do not exist, then weigh the potential for malnutrition against the risk of HIV transmission. Also consider breast milk substitutes in the case of orphans or children with mothers who were killed during the event. In these cases, as with the child of an HIV-infected mother, a wet nurse is an alternative to human milk substitutes.

Feeding programs

In a disaster situation, feeding program options can range from a general feeding program to therapeutic and supplemental feeding programs. It is essential to ensure an equitable and appropriate distribution of available food supplies, with special emphasis on targeting the vulnerable groups. These programs must integrate local habits and preferences to the greatest possible extent.

General feeding programs

These type of programs distributes food to all people affected by the disaster. Ideally, perform a survey of the situation so that the types of food that are delivered meet the specific needs of the population at risk and provide a complete ration of energy, proteins, and micronutrients. General feeding programs can be designed as complementary (providing some food items that are limited or not available) or supplementary (giving nutritional support to vulnerable groups) nutrition.

There are two commonly used forms of ration distribution: wet rations (which can be consumed without further preparation and are distributed at a feeding center) and dry rations (which require cooking and are consumed at the place of residence). There are advantages and disadvantages to each form of ration distribution.

Wet ration distribution ensures that the target individual consumes it, allows for the delivery of complementary health care services, and eliminates safety concerns that must be considered when carrying dry rations to the homes of children and women who can be victims of violence. In addition, when the food is prepared in a community site, participants do not need any fuel supply or cooking utensils. On the other hand, wet rations are labor-intensive, expensive, and increase the risk of disease transmission.

Dry ration distribution is associated with lower cost and can reach larger numbers of individuals with fewer staff resources. Programs in Africa have introduced semisolid supplemental foods with peanut butter (pulpy nut) that have successfully improved early childhood nutritional status in malnourished populations. In addition, the family unit is maintained in their living area with the mother or caregiver spending less time away from the children. Feeding responsibility remains within the family, so that the habits and preferences of the affected population are more likely to be considered.
Therapeutic feeding programs

Therapeutic feeding programs (TFPs) are a complete regimen targeted to provide a carefully balanced and intensively managed dietary regimen, accompanied by medical intervention, to rehabilitate a severely malnourished child. Ideally, refer such severely malnourished children to a hospital for treatment.

TFPs are indicated for individuals with severe malnutrition, as defined by any of the following criteria:
- MUAC <110 mm
- W/H <70%
- W/H Z score <-3 or
- Edema on physical exam

The initial phase in the management must be carried out with increased caution and attention. Direct the first intervention (phase 1) toward stabilization in order to avoid complications (dehydration, hemodynamic disturbances, hypothermia, metabolic and electrolytic disorders) associated with the refeeding syndrome.

Give fluids orally whenever possible. Consider intravenous fluids only for severely dehydrated children with shock. Gradually increase the volume and the calories (starting with a maximum of 100 kcal/kg/day, and no more than 3 g/kg/day of protein) in a 1- or 2-week period according to the patient’s tolerance and progress. Always attempt oral feeding, but if the child cannot tolerate foods by mouth due to severe anorexia or repeated vomiting, nasogastric feeding is indicated. Consider supplementation with potassium, phosphate, magnesium, as well as folic acid, thiamin, vitamin A, and zinc. The regimen should include a multivitamin supplement; folic acid (5 mg on day 1, then 1 mg/day); zinc (2 mg/Zn/kg/day); copper (0.3 mg Cu/kg/day). When the child begins to gain weight, add ferrous sulfate (3 mg Fe/kg/day). Recommended treatment includes a daily regimen provided for at least 2 weeks. Oral supplementation of vitamin A should be provided on day 1: 50,000 IU for children aged <6 months; 100,000 IU for children aged 6 to 12 months; and 200,000 IU for older children. Even in patients with anemia, iron is contraindicated during the initial phase of treatment, as its use may result in decompensation (risk of free radical formation and increased bacterial growth). Iron should not be started until the

** BOX 6. Phases in the therapeutic feeding program **

- **Phase 1:** Intensive care (1-7 days)
  - Initiate rehydration
  - Treat associated disorders (infections)
  - Initiate refeeding: 8-12 feeds/day; 100 kcal/kg/day*

- **Phase 2:** (about 14 days)
  - Continue medical treatment
  - Initiate nutritional rehabilitation: 4-6 feeds/day; >200 kcal/kg/day
  - Transition to social environment
  - Vary diet, incorporate age-appropriate local foods, provide psychosocial stimulation

*The World Organization (WHO) recommendation is to start with basal calories (60-80 kcal/kg/day) and increase the amount by 20 kcal/kg/day every 2 or 3 days according to patient’s tolerance, up to 200 kcal/kg/day.
child has regained a good appetite and is gaining weight (usually in the second week). Once the risk of complications is reduced and the child has regained a normal appetite (kwashiorkor) and a good general appearance and activity, foods more adequate to local habits and preferences can be progressively included (phase 2). At this point, the goal is to reach an intake of 300 kcal/kg/day with a maximum of 3 to 5 g/kg/day of protein. The expected weight gain during phase 2 is 10 to 20 g/kg/day with discharge from the therapeutic feeding program to a supplementary feeding program when a weight for height is maintained at least at 80% of average for at least 2 weeks, with no edema or severe medical problems. Box 6 summarizes the phases of a TFP.

**Supplementary feeding programs**

Supplementary feeding programs are designed to provide nutritional support to individuals with moderate acute malnutrition. The goal of these programs is to provide adequate calories and nutrients to allow for the recovery of normal nutritional status and catch-up growth. The targeted amount of supplementation is approximately 500 to 700 kcal/day, with 15 to 25 g protein/day. Other medical care interventions for these children were described in previous section on the IMCI strategy.
NUTRITIONAL STATUS OF INFANTS 0 TO 2 MONTHS OF AGE

OBJECTIVES

- Assess nutritional status and rule out feeding problems.
- Counsel the mother on effective breastfeeding.

Nutritional status and feeding problems
Assessing nutritional status and feeding problems during the first 2 months of life is a key aspect of health care. Detection of feeding problems and early diagnosis and treatment of infants with reduced weight gain or with weight loss may help prevent disease and death.

Causes of weight loss
A newborn can lose up to 10% of body weight during the first week of life due to edema reabsorption and fluid elimination. Weight loss is strongly conditioned by gestational age, birthweight, type and method of feeding, and other factors associated with morbidity during the first days of life. Consider a weight loss of more than 10% after that age a severe nutritional problem and refer the patient to a hospital immediately.

Weight loss during the first months of life has several causes, but it most frequently is related to feeding problems. Infants who have had repeated illnesses lose weight because of an altered appetite, foods, and caloric losses from vomiting or diarrhea. Infants who are not receiving adequate amounts of breast milk or appropriate alternatives for their age may have severe malnutrition or other nutritional disorders.

Babies younger than 2 months whose diets do not contain the recommended amounts of vitamins and essential minerals (amounts contained in human milk) may later suffer from micronutrient deficiencies. They may not receive the recommended intake of certain specific vitamins (e.g., vitamin A) or minerals (e.g., iron). Diets lacking foods containing vitamin A may result in vitamin A deficiency.

Figure 1 shows the Integrated Management of Childhood Illness (IMCI) algorithm for the assessment of nutritional status in infants 0 to 2 months of age.

Assessment of nutritional status in infants less than 2 months
Ask first about feeding; then assess the weight for age.

Weight loss during the first week of life should not exceed 10% of the birth
weight. If the infant has lost more than 10% of body weight, he/she will be considered to have a severe nutritional problem and must be immediately referred to a hospital to be evaluated by a specialist.

For infants whose weight loss does not exceed 10% of birth weight during the first week of life, weight for age will be evaluated by comparison to the weights of children the same age, using standard growth charts. Identify infants whose weight for age is under the lower percentile in the growth chart. These infants have a very low weight and need special care regarding their feeding.

It is also important to evaluate for good attachment and positioning during breastfeeding. To verify good attachment, check for the following:
- The chin touches the breast (or very close)
- The mouth is wide open
- The lower lip is turned outward
- More areola is visible above than below the mouth

**FIGURE 1. IMCI strategy for the assessment of nutritional status in infants less than 2 months**

For **EVERY** sick child, ask the mother about the child’s problem, assess, and determine that there is **NO** severe neonatal disease or diarrhea. Then

**ASSESS NUTRITION**

**ASK ABOUT FEEDING**
- Has he/she any difficulty in feeding?
- Has he/she stopped eating?
- Since when?
- Is he/she breastfed?
- How many times a day?
- Is he/she receiving other foods?
- Which foods and how frequently?
- Is he/she receiving another milk?
- Which one?
- How is that milk prepared?

**ASSESS AND DETERMINE**
- Weight for age
- Good attachment and positioning during suckling

**CLASSIFY NUTRITION**

**CLASSIFY the infant’s condition using the color-coded table for the classification of NUTRITIONAL status**
To verify the correct position, check if:

- The head and body of the infant are straight
- The infant's head is directed to the mother's breast, with the nose in front of the nipple
- The infant's body is close to the mother's body (belly-to-belly)
- The mother is holding firmly the entire body of the infant, not just the shoulders and neck.

**Classification of nutritional problems**

Nutritional problems are classified into three groups:

- Severe nutritional problem
- Feeding problems
- No feeding problems

Assess feeding in EVERY infant younger than 2 months of age, with special care for those who:

- Are not exclusively breastfed
- Are receiving other foods
- Have very low weight or low weight for age

Table 12 shows the classification of nutritional status according to IMCI guidelines. It is always important to counsel the mother on the appropriate breastfeeding technique and to encourage breastfeeding (Box 7).

### BOX 7. Correct technique for breastfeeding (attachment and position)

- **Check for lesions on the nipples**
- **Show the mother how to hold the infant**
  - With the body and head straight in one line
  - With the body of the infant close to hers (belly contact)
  - Holding the whole body of the child with her arm

- **Show the mother how to help the infant get a good attachment while suckling**
  - Touch the infant's lips with the nipple
  - Wait until the infant opens his/her mouth wide
  - Get the infant close to the breast quickly and make sure that the lower lip stays well under the nipple

- **Check for signs of good attachment and suckling. If they are not good enough, try again**
- **Check that the mother is at ease**
- **Give support and reinforce the mother's role**
### TABLE 12. Classification of nutritional status

<table>
<thead>
<tr>
<th>Assess signs</th>
<th>Classify as</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(RED)</strong></td>
<td></td>
<td><strong>(RED)</strong></td>
</tr>
<tr>
<td>• Weight loss &gt;10% in the first week</td>
<td>SEVERE NUTRITIONAL PROBLEM</td>
<td>• URGENTLY refer to hospital</td>
</tr>
<tr>
<td>• Decreasing weight curve on growth chart</td>
<td></td>
<td>• Prevent hypoglycemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prevent hypothermia</td>
</tr>
<tr>
<td><strong>(YELLOW)</strong></td>
<td><strong>(YELLOW)</strong></td>
<td><strong>(YELLOW)</strong></td>
</tr>
<tr>
<td>One of the following signs:</td>
<td>FEEDING PROBLEMS</td>
<td>• If weight for age is &lt;10th percentile or the weight curve has a horizontal or descending tendency refer to the pediatrician</td>
</tr>
<tr>
<td>• Horizontal weight curve on growth chart</td>
<td></td>
<td>• Counsel the mother to breast-feed the infant as many times and as much as he/she wants, day and night, at least 8 times a day</td>
</tr>
<tr>
<td>• Weight for age &lt;10th percentile</td>
<td></td>
<td>• If there is not a good attachment or the infant is suckling poorly, teach the mother the appropriate positioning and attachment</td>
</tr>
<tr>
<td>• Holds poorly to the nipple</td>
<td></td>
<td>• If the infant is receiving other foods or fluids, counsel the mother to breastfeed more frequently, progressively reducing other foods and fluids until complete discontinuation, and not to bottle-feed the infant</td>
</tr>
<tr>
<td>• Suckling poorly</td>
<td></td>
<td>• If the infant is not breast-fed:</td>
</tr>
<tr>
<td>• Breastfed fewer than 8 times a day</td>
<td></td>
<td>• Refer for counselling on breast-feeding so it can be initiated or reassumed</td>
</tr>
<tr>
<td>• Receiving other foods or fluids</td>
<td></td>
<td>• Start recommended vitamin supplement</td>
</tr>
<tr>
<td>• Receiving other milk</td>
<td></td>
<td>• If necessary, teach how to correctly prepare formula and to use a cup</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Follow-up 2 days later to check for any feeding problem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Perform a weight monitoring after 7 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Teach the mother preventive measures</td>
</tr>
<tr>
<td><strong>(GREEN)</strong></td>
<td></td>
<td><strong>(GREEN)</strong></td>
</tr>
<tr>
<td>• Normal weight for age and no feeding problems</td>
<td>NO FEEDING PROBLEMS</td>
<td>• Congratulate the mother on the good care of the infant and reinforce the counselling</td>
</tr>
<tr>
<td>• Curve showing weight gain</td>
<td></td>
<td>• Schedule a follow-up visit according to guidelines for growth and development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Teach the mother preventive measures</td>
</tr>
</tbody>
</table>
Adequate nutrition is vital to everyone's health and well-being. Even in the best of times there are multiple challenges to proper nutrition. These challenges are greatly increased in the aftermath of a natural or man-made disaster. An understanding of the local community and reliable information on local resources are critical in the development of a recovery strategy. It is important to remember that malnutrition increases morbidity and mortality of the affected population, particularly among the most vulnerable groups, such as children. Assessing the nutritional status of the population (through anthropometric measurements), identifying macro- and micronutrient deficiencies, and implementing preventive and therapeutic strategies increase dramatically the likelihood of successful recovery among populations affected by a disaster. Under these circumstances, the IMCI primary health care strategy provides a reasonable approach to enhance the achievement of this goal.


SUGGESTED BIBLIOGRAPHY


Case resolution

Case 1

In order to collect information on the nutritional status of the affected population prior to the disaster, it would be useful to get in contact with the local public health authorities and health professionals. It is also necessary to collect information regarding the most vulnerable groups (e.g., people included in pre-existing food programs). Lastly, it is necessary to have information regarding the available food resources in order to develop the most appropriate and sustainable distribution programs for the aftermath of the disaster.

Case 2

Since this is a preterm infant, it is important to ensure adequate iron intake earlier than in term infants. At 4 months of age the infant should not be receiving any supplementary foods in addition to breastfeeding. The infant should therefore be supplemented with iron at a dose of 2 mg/kg/day.

Case 3

You must first look for signs indicating malnutrition and anemia. There is no serious wasting or edema in the lower extremities. The palms are slightly pale. The anthropometric measurements show a 40% weight/height deficit when compared with standard weight/height growth charts: very low weight for age. He is therefore classified as having severe malnutrition and must be referred to a hospital for proper treatment. In these children, the therapeutic refeeding program must be careful to avoid the refeeding syndrome and the associated increased morbidity and mortality.
MODULE REVIEW

SECTION I - NUTRITIONAL STATUS ASSESSMENT

1. How would you assess the nutritional status of a population affected by a disaster?
2. What are the most vulnerable populations in an emergency setting?
3. What anthropometric measurements are used to assess nutritional status in children?

SECTION II - CLINICAL PRESENTATION OF MALNUTRITION

1. What are the clinical features of severe protein-energy malnutrition (PEM)?
2. What are the physiologic features in severe malnutrition that increase the risk for the refeeding syndrome?
3. What are the clinical and physiologic manifestations of the refeeding syndrome?

SECTION III - MICRONUTRIENT DEFICIENCIES

1. What are the epidemiologic and clinical implications of iron, vitamin A, and zinc deficiencies?
2. Which interventions allow the prevention or correction of micronutrient deficiencies in a population affected by a disaster?

SECTION IV - IMCI STRATEGY FOR NUTRITIONAL STATUS ASSESSMENT

1. What elements are used to classify malnutrition and anemia according to the IMCI guidelines?
2. What factors determine the appropriate management for each category?

SECTION V - FEEDING PROGRAMS IN DISASTER SITUATIONS

1. What are the logistic and nutritional benefits of breastfeeding?
2. What are the goals and characteristics of the different feeding programs that can be used in these situations?
3. What are the phases of a therapeutic feeding program?
SECTION VI - NUTRITIONAL STATUS OF INFANTS
0 TO 2 MONTHS OF AGE

1. What is the expected change in body weight for the newborn during the first days of life?
2. Which nutritional deficiencies may be associated with non-exclusive breast-feeding?
3. Which elements are included in the assessment of the nutritional status in infants younger than 2 months of age?
4. What are the characteristics of a good attachment and position during suckling?
5. What is the treatment for feeding disorders in this age group?
### Treatment of Hypophosphatemia

<table>
<thead>
<tr>
<th>Degree of Hypophosphatemia</th>
<th>IV Phosphate Replacement Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3-2.7 mg/dL, asymptomatic</td>
<td>0.08-0.16 mmol/kg</td>
</tr>
<tr>
<td>1.5-2.2 mg/dL, asymptomatic</td>
<td>0.16-0.32 mmol/kg</td>
</tr>
<tr>
<td>&lt;1.5 mg/dL, symptomatic</td>
<td>0.32-0.64 mmol/kg</td>
</tr>
</tbody>
</table>

*Note: Ensure adequate renal function: in patients with renal insufficiency give 50% initial dose.*


### Treatment of Hypokalemia

<table>
<thead>
<tr>
<th>Degree of Hypokalemia</th>
<th>IV Potassium Replacement Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5-3.4 mEq/L</td>
<td>20-40 mEq @ 10-20 mEq/hour</td>
</tr>
<tr>
<td>&lt;2.5 mEq/L</td>
<td>40-80 mEq @ 10-20 mEq/hour</td>
</tr>
</tbody>
</table>

*Note: Ensure continuous cardiorespiratory monitoring.*


### Treatment of Hypomagnesemia

<table>
<thead>
<tr>
<th>Degree of Hypomagnesemia</th>
<th>IV Magnesium Replacement Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1.5 mg/dL</td>
<td>1-4 g magnesium sulfate, up to 1 mEq/kg</td>
</tr>
<tr>
<td>&lt;1 mg/dL</td>
<td>4-8 g magnesium sulfate, up to 1.5 mEq/kg</td>
</tr>
</tbody>
</table>

*Note: Ensure adequate renal function: in patients with renal insufficiency give 50% initial dose.*

1 g magnesium sulfate = 8.1 mEq magnesium

**APPENDIX**

**High-energy milk**

Nutritional therapy during phase 1 is designed to deliver a maximum of 100 kcal/kg/day and no more than 3 g protein/kg/day. One way to accomplish this is to use high-energy milk (HEM) with an energy density of 1 kcal/mL (see recipe below). The goal is to provide 100 mL HEM/kg/day. This provides 100 kcal and 2.9 g protein/kg/day.

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight (g)</th>
<th>Kcal</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried skim milk</td>
<td>80</td>
<td>28.8</td>
<td>285</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>60</td>
<td>0</td>
<td>530</td>
</tr>
<tr>
<td>Sugar</td>
<td>50</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1 liter</strong></td>
<td><strong>28.8</strong></td>
<td><strong>1015</strong></td>
</tr>
</tbody>
</table>

*Water is added to the dry ingredients to make 1 liter of HEM (approximately 900 mLs)

Adapted from Médecins sans Frontières, Nutritional Guidelines, 1995

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**Recipe 1: Maize flour-dried skim milk (DSM) based porridge**

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight (g)</th>
<th>Kcal</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>60</td>
<td>215</td>
<td>6</td>
</tr>
<tr>
<td>DSM</td>
<td>45</td>
<td>160</td>
<td>16</td>
</tr>
<tr>
<td>Oil</td>
<td>30</td>
<td>265</td>
<td>0</td>
</tr>
<tr>
<td>Sugar</td>
<td>15</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Water</td>
<td>400</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>550</strong></td>
<td><strong>700</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>

**Recipe 2: Corn-soya blend (CSB) based porridge**

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight (g)</th>
<th>Kcal</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSB</td>
<td>100</td>
<td>380</td>
<td>18</td>
</tr>
<tr>
<td>Oil</td>
<td>30</td>
<td>265</td>
<td>0</td>
</tr>
<tr>
<td>Sugar</td>
<td>20</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>Water</td>
<td>300</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>450</strong></td>
<td><strong>725</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>
The porridge can be prepared for children receiving therapeutic feeding, as well as for children at wet supplementary feeding centers.

Usually, a porridge will provide ~150 kcal/100 mL and ~4 g of protein/100 mL

**Preparation:**
Add 1 volume of premix to 2 to 3 volumes of water. Boil for 10 to 15 minutes.
Always prepare a sample and taste the porridge before distribution. The porridge should be semi-liquid. Cooked porridge should not be kept for more than 2 hours.

Adapted from *Médecins sans Frontières. Nutritional Guidelines. 1995*

**Norms for calculating rations**
1. Each meal should include recommended rations or, when this is not feasible, at least one type of food from each group. If enough food is not available, each person should be provided with one type of food from each available group. If a certain food group is not available (e.g., fruits and vegetables) dehydrated or canned food may be provided. As a last resort, the ration should be supplemented with foods from another available food group.

2. Within the same food group, select different foods. Diversifying the diet with different cereals (rice, corn, potato, wheat) and legumes (beans, chick-peas, broad beans, lentils), as well as with different fruits and vegetables that may be available helps to prevent vitamin and mineral deficiency.

3. Vegetable oils should always be considered an important and concentrated source of energy and essential fatty acids. Hence, it is important to supply different types of oil (corn, soy, palm, safflower, etc.) and, when possible, different seeds.

4. Including legumes (beans, lentils) or animal products (canned tuna fish, dry meat) together with cereals (corn tortillas, rice, potato, and fortified cereals) in one meal provides high biological value proteins. Likewise, absorption is facilitated by the inclusion of foods rich in vitamin C (citrus fruits and processed juices) with iron sources of lower bioavailability (dark green leafy vegetables). This diet increases dietary energy value.

Small amounts of animal products are needed, and they provide high biological value amino acids. Widely consumed local cereals have the highest proportion of nutrients.
### Ration distribution by food groups for an energy supply of 2,100 kcal/day

<table>
<thead>
<tr>
<th>Group</th>
<th>OPTION A</th>
<th>OPTION B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>8 rations (640 g) (8 corn tortillas or 4 cups of rice, potato, corn, or cooked pasta)</td>
<td>11 rations (850 g) (11 corn tortillas or 4 cups of rice, potato, corn, or cooked pasta)</td>
</tr>
<tr>
<td>Animal products</td>
<td>0</td>
<td>3 rations (90-100 g) (150 g of cooked meat, poultry, fish, or turkey, or 50-60 g of dried meat)</td>
</tr>
<tr>
<td>Legumes*</td>
<td>7 rations (350 g cooked or 245 g raw) (3 1/2 cups of cooked beans, broad beans, chick-peas, lentils, or haricot beans)</td>
<td>2 rations (200 g cooked or 70 g dry) (1 cup of beans, broad beans, chick-peas, lentils, or haricot beans)</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>2 rations (120 g) (one medium-sized fruit or a cup of fruits and a handful of vegetables)</td>
<td>3 rations (180 g) (1 1/2 cup of fruits and a handful of vegetables, or 2 medium-sized fruits and a handful of vegetables, or 12 dried fruits and a handful of vegetables)</td>
</tr>
<tr>
<td>Oil</td>
<td>55 mL (11 teaspoonfuls)</td>
<td>45 mL (9 teaspoonfuls)</td>
</tr>
<tr>
<td>Sugar</td>
<td>25 g (5 teaspoonfuls)</td>
<td>30 g (6 teaspoonfuls)</td>
</tr>
</tbody>
</table>

*A ration of raw legumes weighs 35 g.*
Module 9

The Emotional Impact of Disaster on Children and Families

Brian Stafford | David Schonfeld | Lea Keselman | Carmen López Stewart
INTRODUCTION

In addition to their disastrous effects on the life and infrastructure of communities, events produce a massive collective stress exceeding the ability of the affected population to cope with the physical, emotional, and financial burdens. Disaster episodes affect millions of people and exert a collective social suffering that requires a monumental effort by individuals, communities, societies, and the world community to overcome.

Classically, relief efforts focus on the physical consequences of disasters by providing immediate medical attention and addressing health and environmental services (water supply, sewage disposal, and shelter). Only in recent years have the short and long-term emotional and mental health consequences among exposed individuals been taken into consideration. By definition, coping with a disaster challenges the individual’s adaptive capacity.

Children and adolescents are emotionally vulnerable to their experiences during a disaster. However, a child’s reaction to a disaster varies widely depending on circumstances such as: (1) the extent of exposure to the event, (2) the amount of support during the disaster and its aftermath, and (3) the amount of personal loss and social disruption. In addition, the child’s response and adaptation are influenced by the child’s developmental stage, degree of dependency on adults, unique individual
characteristics, and the child’s previous experience. In most cases the child’s emo-
tional response after a disaster represents an “expected” adaptive behavior. However this “expected” adaptive behavior can become a significant mental health problem that will chronically impair a child’s social and emotional development when it is too intense and or persistent. Therefore the early identification of intense and problematic responses requires adequate support and treatment, according to the emotional needs and developmental stage of each child. It is essential to educate adults who provide care (parents, teachers, pediatricians) about stress symptoms and normal and abnormal adaptive reactions. Knowing when to intervene promptly is important, because traumatic experiences during childhood are associated with a higher risk of later emotional and behavioral disorders, including antisocial behaviors. It is also important to prevent these more serious disorders and behaviors with anticipatory guidance and early intervention since the availability of pediatric mental health professionals is quite limited, especially in developing countries. Training pediatricians and school based staff has the potential to greatly enhance the effective management, early intervention, and support for children and families affected by a disaster so that the majority of impacted children will adjust and recover functioning.

This module provides information on the emotional consequences of exposure to massive incidents among children and adolescents, describes the criteria for the identification of more serious mental health disorders, and proposes strategies for the referral and management of children at different developmental stages.
The human impact of a disaster is affected by the vulnerability of the children and adolescents involved in the event. Although disasters impact almost everyone in the area, certain populations have characteristics that predispose to having a higher risk of negative consequences.

The psychological well-being of individual children is influenced by the following: 1) the type and intensity of exposure to the event, 2) the availability of family support during the event and during recovery, 3) the degree of day-to-day life disruption, and 4) the amount of social disorganization and chaos. In addition vulnerability depends on individual characteristics of the child, the social and economic circumstances of the family and community, and the available resources in the surrounding environment and community.

**Individual characteristics that influence vulnerability**

Emotional reactions in children vary according to the personal characteristics of the child or adolescent:

- **Age or developmental stage** (physical, psychological, and social)
- **Degree of dependency on adults in the family or caregivers**
- **Gender**
- **Previous physical and mental health**
- **Resilience**

**Age or developmental stage of the child**

A child’s age and developmental stage will modulate the emotional response to a disaster. If not physically impaired by the trauma, a child’s intrinsic adaptive capacity will allow the resumption of normal play, educational, and other developmentally appropriate activities.

**Degree of dependency on adults in the family or caregivers**

Infants, toddlers, and preschoolers are nearly completely dependent on adults for
their care. School-age children are also very dependent on adults. Adolescents while less dependent, may lack experience and cognitive ability to understand and anticipate the immediate or longer-term consequences of the disaster. On the other hand, adolescents may be more self-sufficient and react in a manner somewhat independent from their caregivers. The adaptive capacity of nearly all children is influenced by the emotional availability of their caregivers, but this is especially true for younger children. They may experience intense feelings of abandonment when separated from adults in the family who have been injured, dislocated, killed, or who are doing community work.

**Gender**
Cultural and biological differences between girls and boys make it more likely for boys to have more disruptive or externalizing behavioral symptoms and longer recovery periods than girls. Boys tend to react with aggressive behavior, violence, and antisocial attitudes, which can expose them to additional trauma. Girls, on the other hand, are more at risk for internalizing disorders such as depression and anxiety. Girls are also at risk for interpersonal violence (rape) during and following a disaster. In some cultures, girls may be more willing and able to verbalize their experiences.

**Previous physical and mental health**
Having a chronic physical disease is a risk factor for poor adaptation following a disaster. In addition, a previous history of trauma, loss, family distress, or emotional/behavioral problems increases the likelihood of a more intense and persistent emotional disturbance after disasters.

**Resilience**
Resilience is an adaptive capacity that allows an individual to cope more effectively with adverse circumstances. In spite of their vulnerability, many girls and boys have inner resources that enable them to be resilient in disaster situations. Resilience may be related to inherited temperament, but it is more likely influenced by having had a nurturing caregiver who helped them develop self-confidence and adaptive skills to cope with traumatic circumstances.

More resilient children are able to focus their energy on developmentally appropriate activities such as play, friendships, and learning. To the extent possible it is best to minimize the degree to which children are made to assume parental roles that are inconsistent with their own developmental and emotional needs.

**Factors that influence the emotional impact on children in disaster situations**
Events that cause a great deal of damage or long-lasting disruptions, or occur with little warning, tend to cause a greater degree of distress. Factors that influence the type and intensity of the emotional impact experienced by affected children are shown in (Box 1).

**Type, extent, and duration of disaster**
Acute situations of short duration that generate few changes in everyday life...
cause less psychological damage than those that are prolonged and cause extensive damage to the social environment.

Direct exposure to disaster
When children are direct witnesses to the impact of a disaster, the emotional consequences are more severe.

Perception of life-threat to self or significant other
A perceived threat to an individual’s life is as important to assess as any objective risk, since the perception of a life-threat is a strong risk factor for developing an emotional disorder. In children, their belief that their parent might die is also a significant risk factor for developing PTSD.

Separation from caregivers
Children who suffer trauma are more likely to develop PTSD if they are not with their parents - or are separated from their parents - immediately after the event.

Physical injury
Physical injury and related pain is associated with chronic PTSD symptoms.

Effects on parents or caregivers
Children are sensitive to how a disaster has affected families and community. Adults, who normally provide support, protection, and stability may be unable to provide shelter, food, or safety. They may fail to respond appropriately to their child’s emotional distress because they are incapacitated by their own emotional response. Children are affected by their caregiver’s response to an event. An overwhelmed caregiver frequently leads to a distressed child. Emotional or behavioral disorders manifested by caregivers increase a child’s feelings of insecurity and fear; making long-term emotional and behavioral disorders more likely.

Family inner resources: relationships and communication among family members
Families characterized by tense and conflicting relationships prior to the disaster are more likely to react in nonadaptive and disorganized manners. This reinforces feelings of helplessness and insecurity in children.

Exposure of children to mass media
Repetitive exposure of children to terrifying images on television has an emotional impact on children. Children may misunderstand these images and believe that the event is ongoing. Graphic images can overwhelm and frighten younger children and impact older children and adolescents as well. Indirect exposure to disaster through TV images is associated with anxiety and other emotional disturbances in children not directly exposed to the disaster. Adults should monitor and restrict images that their children are exposed to through all media, but especially through television.

Cultural differences
Children and families who have previously endured traumatic experiences, including violence, abuse, and separation from caregivers have a greater risk of experi-
SECTION 1 / EMOTIONAL VULNERABILITY

Box 1. Factors that influence the emotional impact on children in disaster situations

- Type, extent, and duration of the disaster
- Direct exposure to disaster
- Perception of life-threat to self or significant other
- Separation from caregivers
- Physical injury
- Effects on parents or caregivers
- Inner resources: family relationships and communication pattern among family members
- Exposure of children to mass media
- Cultural differences
- Degree of disorganization and disruption to daily routines and loss of social control in the community
- Community response

Disasters may generate situations of chaos and disruption that undermine the normal rule of law and lead to desperate and criminal behavior such as looting, robbery, and vandalism. The frequency of interpersonal violence including rape of women and sexual abuse of children increases in these circumstances.

Community response to the needs of children affected by disaster

The more social cohesiveness the community retains the quicker that society will gain a sense of stability, normalcy, or, at least, hope. Communities recover quicker if prior to the disaster they have prepared a plan for responding and rebuilding. Having a community response and recovery plan that is implemented in a prompt, effective, and coherent manner will create a more supportive environment that lessens the risk for long-term emotional disorders.

Experiencing serious adverse emotional reactions to disaster. A strong and extensive social network may serve as a protective buffer. Likewise, some religious beliefs may serve as protective factors for children and their families.
OBJECTIVES

- Know the stages of the emotional response to a disaster
- Know the most common emotional disorders in children exposed to disaster situations
- Recognize the cases that require referral for mental health professional assistance

Normal emotional response
When a child is exposed to a disaster, the emotional responses can range from minimal distress to inattention, fear, lack of enjoyment (anhedonia), anxiety, depression, and grief to symptoms of re-experiencing, avoidance, hypervigilance, and disruptive behavior.

In many instances these symptomatic reactions are considered normal responses to a traumatic experience and are time-limited. Children, however, may also have significant impairment and chronic symptomatology.

Stages of normal emotional response of children to disaster
The emotional response to traumatic stress can be viewed in stages. There are a range of emotional responses or reactions that can be seen, some of which are more likely to occur during or immediately after the disaster and some which are more likely to be seen at a later time.

The first stage, occurring immediately after the traumatic experience may include reactions of fear, denial, confusion, and sorrow as well as feelings of relief if loved ones are unharmed. It may also include dissociative symptoms: feelings of emotional numbing, being in a daze, a sense of what has occurred is not real or that one doesn’t feel like oneself, or lack of memory for some aspects of the experience (amnesia).

The second stage occurs days or weeks after the disaster. In many children it is characterized by regressive behavior and signs of emotional stress such as anguish, fear, sadness, and depressive symptoms; hostility and aggressiveness against others; apathy, withdrawal, sleep disturbance, somatization, pessimistic thoughts about the future, and repetitive play enactment of the trauma. As long as these symptoms do not impair normal childhood activities, they are considered part of the normal recovery process and they can be expected to lessen or disappear after some weeks.

Emotional responses that are persistent and impair a return to normal functioning should be considered pathologic. These responses may be related to
The most frequent childhood disorders following a disaster are in the areas of anxiety, mood, and behavior.

Although grief is not a mental disorder, it may require or benefit from professional attention, especially if it is complicated by an emotional disorder such as depression or PTSD. Traumatic deaths are of particular concern for precipitating severe grief reactions in disasters.

Five factors that increase the risk of “traumatic grief” are:
- Sudden, unanticipated deaths.
- Deaths involving violence, mutilation, and destruction.
- Deaths that are perceived as random or preventable, or both.
- Multiple deaths.
- Deaths witnessed by the survivor that are associated with a significant threat to personal survival or a massive or shocking confrontation with death and mutilation.

The most frequent childhood disorders following a disaster are in the areas of anxiety, mood, and behavior (Box 2).

Severe stress reaction and adaptive disorders (F43), acute stress reaction, and post-traumatic stress disorder (F43.1)

Post-traumatic stress disorder (PTSD) is a clinical entity that commonly occurs after exposure to a traumatic event. A traumatic event threatens the physical or psychological integrity of the affected person, and is associated with feelings of confusion, insecurity, terror, and bewilderment.

Data on the prevalence of PTSD in childhood vary widely, reflecting the individual experience of the children and families as well as the amount of personal and communal loss.

The International Classification of Diseases (ICD-10) defines PTSD as a disorder that “arises as a delayed or protracted response to a stressful event or situation (of either brief or long duration) of an exceptionally threatening or catastrophic nature, which is likely to cause pervasive distress in almost anyone.” The Diagnostic and Statistical Manual of Mental Disorders, 4th ed., Text Revision (DSM IV-TR), requires a number of criteria to be met by the individual to establish a diagnosis of PTSD (Box 3).

Re-experiencing the traumatic event
Children may experience recurrent, intrusive, and pervasive thoughts regarding the traumatic event. This occurs as flashbacks...
or repetitive dreams, or nightmares. These dreams may not necessarily contain images drawn from the traumatic event; in fact, the frightening dreams may have no recognizable content. Younger children may act out what they have witnessed—in all of its intensity—or they may engage in joyless repetitive play in which themes or aspects of the traumatic experience are re-enacted. Other symptoms include emotional and physiological reactivity to certain reminders (cues) of the event such as smells, images, sounds, or similar emotional triggers.

Avoidance and numbing
Affected individuals frequently avoid passing through places, conversations, or situations that trigger any painful recollection of the traumatic event. Avoidance in children may take the form of closing or covering their eyes when in proximity to the traumatic scene or other reminder. They may also have tantrums prior to returning to a site of traumatization. Numbing behavior is recognized when children often lose interest in activities they used to enjoy. A child, who once had a full range of emotional expression, may look withdrawn, restricted, and indifferent. Affected children may also seem emotionally detached from significant others. Some older children and adolescents may report a sense of not caring or doom about the future.

Symptoms of increased arousal
Hyperarousal is manifested through sleep disturbance that can include nightmares, fear of sleeping alone, or difficulty initiating or staying asleep. Difficulties in concentration make learning difficult. Hypervigilance and an exaggerated startle response may lead to excessive irritability or angry outbursts and may make interpersonal relations quite difficult, especially within the family.

**BOX 3. DSM IV-TR diagnostic criteria for PTSD**

- Exposure to a traumatic event
- Persistent re-experiencing of the event, as evidenced by
  - Distressing recollections,
  - Dreams,
  - Flashbacks,
  - Distress at cues,
  - Physiological reactivity to cues
- Avoidance of stimuli associated with trauma and symptoms of numbing of general responsiveness, as evidenced by
  - Avoidance of thoughts and feelings
  - Avoidance of activities, places, people
  - An inability to recall aspects of the event
  - Decreased interest/participation in social activities
  - Emotional Detachment
  - Restricted affect
  - Foreshortened sense of future
- Symptoms of increased arousal, as evidenced by:
  - Insomnia
  - Irritability
  - Difficulty concentrating
  - Hyper-vigilance
  - An exaggerated startle

To establish the diagnosis, symptoms must be present for at least one month and should be associated with considerable impairment of child’s normal activity.
SECTION II / EMOTIONAL RESPONSE

Other symptoms
Other associated symptoms that frequently co-occur include regressive behaviors, such as thumb-sucking, enuresis, and encopresis, as well as other phobias and anxieties, multiple somatic symptoms (stomachaches and headaches), and disruptive behavior.

PTSD manifestations vary according to the development stage of the affected child, making it possible to describe them in three groups: preschool-age children, school-age children, and adolescents.

PTSD in Preschool-age children
Toddlers, and preschool-age children can experience PTSD symptoms but they often cannot verbally communicate their distress. Instead, they frequently look withdrawn, silent, indifferent, quiet, fearful, demonstrate regressive behaviors and fears especially increased separation anxiety. They may re-enact intrusive memories through repetitive play of the trauma.

PTSD in School-age children
Older children can manifest all of the symptoms of post-traumatic stress disorder, including irritability as well as emotional constriction. They often suffer from difficulties in attention that impair their concentration at school. In addition, somatic symptoms, such as headaches and stomachaches, are typical. Their worries about the disaster might become pervasive. They may attempt to prevent future dangers by asking questions about aspects of the event, including minor details that may seem obsessional. They may also re-enact troubling recollections through play or drawing.

PTSD in Adolescents
Adolescents can experience all of the symptoms of PTSD that adults can. They may have recurrent thoughts or dreams about the incident that may lead to feelings of anxiety, depression, helplessness, and guilt, and suicidal ideation. Occasionally, in an attempt to relieve their distress, they may increase their use of illicit substances. In addition, they may demonstrate rebellious and antisocial behavior.

Depressive disorders
Signs of depression such as sadness, hopelessness, and sleep disturbance are common manifestations after a catastrophic event. This is especially true when the return to normal routines and settings is delayed or impossible. Symptoms of depression can be temporary or chronic and may require intervention of medical and mental health professionals. Pediatricians and general practitioners who care for children exposed to disaster should identify the appearance and persistence of the following symptoms of depression:

- Sleep disturbance: insomnia, hypersomnia, nightmares
- Eating pattern disturbances: rejection of food or excessive feeding/eating
- Feelings of hopelessness and helplessness
- Feelings of frustration, irritability, restlessness, emotional outbursts.
- Reduced or no interest in usual everyday activities, feelings of discouragement (despondency)
- Reduced or no capacity for enjoyment of activities that were usually pleasant
- Loss of interest in playing
- Loss of interest in relating with peers
- Loss of friends
- Regressive behaviors (going back to earlier developmental stages)
- Tendency towards withdrawal and annoyance
- School performance problems
- Somatic symptoms since they are sometimes equivalent to depressive symptoms (e.g. headaches, stomachaches among the most frequent)
- Suicidal thoughts or suicidal ideation in adolescents and older children, requiring immediate attention by mental health professionals

**Anxiety disorders**
Symptoms of anxiety may appear at all ages. Among the most frequent include:

- Fears (often of the dark)
- Irritability
- Restlessness
- Avoidance behavior
- Recurrent stressful thoughts or feeling of being in danger
- Recurrent images
- Attention, concentration, and memory disturbances
- Shaking
- Dizziness, instability
- Tachycardia, dyspnea, chest pain
- Muscle contracture
- Gastrointestinal disorders (diarrhea, constipation)
- Sweating

**Conduct disorders of defiant and aggressive behavior**
Aggressive behavior is also a frequent outcome among children and adolescents, especially males. Whereas younger children may hit or bite others, older children may get quite violent, especially with their peers, and pushing and fighting becomes common. Rebellious, antisocial, and even criminal behavior can also occur.

When greatly distressed, children and adolescents may enact their distress through somatic symptoms, emotional outbursts, and other disruptive behavior. Parents may be tempted to over-react to somatic symptoms or pardon disruptive behavior due to feelings of guilt related to an inability to protect their children. Parents should attempt to sensitively provide consistent limits and to provide opportunities to discuss their child’s fears, anger, sadness and other emotions without relying upon the child for their own comfort.

**Other manifestations**
Children and adolescents frequently express emotional distress through somatic symptoms. The most common include headaches, stomachaches, chest pain, and nausea. These symptoms typically improve when kids are given the chance to express their feelings in an appropriate modality – play, drawing, talking. It is important to be alert to these symptoms and make the corresponding consultation if they persist.

Special mention is needed for sleep disturbances. Insomnia, refusal to go to sleep, frequent waking, nightmares, night terrors, and fears of sleeping alone are very common. Adults should be sensitive that this is related to a child’s sense of security and respond appropriately and flexible. Bedtime rituals should resume; in addition, spending more time with children near bedtime, providing a soothing
transitional object (doll, stuffed animal), leaving a light on, and staying with them until they are asleep are possibilities.

Younger children have cognitive processes that are egocentric, and may believe that they are to blamed for not behaving or for negative thoughts and fantasies. Excessive feelings of guilt and inappropriate self-blame may also arise in older children and adolescents for having survived or for being unable to prevent their loved ones from being injured or killed. It is necessary that children understand that they are not responsible for what happened in order to prevent inappropriate feelings of guilt.

Regressive behavior is very common, especially among younger children whose developmental achievements are not as well consolidated. They become more dependent on adults, perhaps even clinging to them, and symptoms of separation anxiety or school refusal may appear. They may often regress to thumb-sucking, fearing the dark, wetting the bed, and even have encopretic episodes.
SPECIFIC INTERVENTIONS

OBJECTIVES

- Describe the different types of interventions for emotional responses seen in children at differing developmental stages
- Be aware of recommendations to restore routines and child and family functioning
- Be acquainted with the possible interventions aimed at lessening the emotional impact of disasters childhood

Interventions for emotional disorders in children exposed to a situation of disaster

Children with adverse reactions to stress and behavioral symptoms for more than 1 month are at higher risk of developing PTSD or violent or criminal behaviors in the future. They should therefore receive psychological support within the first month after the episode.

Most children present first to primary care clinicians or to non-mental health professionals. Primary care clinicians play an important role in educating families about prevention and support strategies, providing early intervention, screening for emotional disturbance, providing less intensive interventions, and referring for mental health and community-based treatment (Box 4). Pediatricians have the capacity to provide appropriate anticipatory guidance and manage emotional conditions early on, when these conditions may be ameliorated. Prompt measures to minimize fear and anxiety in children exposed to a traumatic event are essential. These measures should give children the certainty that adults are in control.

CASE 1

An important part of the population in your city has been affected by a flood, prompting an evacuation plan that involves displacement of most people to shelters. You have been summoned as part of the multidisciplinary rescue teams.

- As a pediatrician, what do you consider to be your role in helping families during the first days?

CASE 2

After an earthquake the population of your town is progressively returning to normal. Children are gradually returning to school.

- What do you think should be your role in this phase regarding school and school teachers?

BOX 4. Pediatrician’s role

- Provide anticipatory guidance
- Manage early disturbance
- Screen for disorders
- Provide less intensive intervention
- Refer for mental health and community-based treatment
Following a disaster, the primary mental health goals in the initial 1 to 2 months are to restore stability, improve social networks, decrease hyperarousal, and help natural recovery seeking. Anticipatory guidance for post-trauma emotional symptoms includes describing the types of distress, explaining that many symptoms are a normal response, and describing measures to help the child and family adapt to the stressor and return to previous functioning. This guidance can be given to individual families, to educators, and to the media. In general, these universal recommendations include the following:

- Return to normal routines
- Be patient and supportive and give children time to adapt to his/her distress
- Continue to set normal and appropriate limits on the child’s behavior
- Allow children to talk about his/her worries and feelings if desired
- Encourage the child to spend time with friends
- Encourage children to return to his/her previous developmental tasks
- Parents are encouraged to deal with their own feelings and get support and treatment if indicated

More in-depth individual counseling and anticipatory guidance should be developmentally based (Box 5).

**Notification of death**

One of the most difficult experiences that a pediatrician will have during a disaster is notifying the family of a death; whether a child or parent has died. It is best to do this in person and not in a telephone call whenever possible regardless of the time of day. It will also be preferable to deliver this news in a private place, away from the distractions of ongoing care to patients. The manual entitled *Pediatric Terrorism and Disaster Preparedness: A Resource for Pediatricians* describes the notification process as follows:

“After notifying the survivor(s) of the death, pause to allow both the information to be processed and emotions to be expressed. Do not try to fill the silence, even though it may seem awkward. Listen more than you speak. Silence is often better than anything you can say. Stay with the family members as they are reacting to the news, even if they are not talking.

- Use clear and simple language. Avoid euphemisms such as terminated, expired, or passed away. State that the individual died or is dead.
- Don’t provide unnecessary graphic details. Begin by providing basic information and allow the individual to ask

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**Box 5. How can we help the children?**

**Recommendations for promoting adjustment to stressful and traumatic events**

**A. Understand emotional reactions**
- Pay attention to behaviors at home and at school or child care
- Acknowledge and accept behavior as normal adaptations to stress

**B. Reduce the emotional impact**
- Provide support, comfort, and time for play and discussion
- Model healthy coping behavior
- Have parents seek help if needed

**C. Facilitate recovery**
- Normalize routines as soon as possible
- Listen to children and validate their feelings
- Encourage activities that help them express their feelings: different type of games, art-related activities, etc.
Questions for more details.

- Don’t lie or speculate. If you do not know the answer to a question, say so. Try to get the answer if possible.

- Be conscious of nonverbal communication and cues, both those of the family as well as your own.

- Be aware of and sensitive to cultural differences. If you do not know how a particular culture deals with a death, it is fine to ask the family.

- Consider the use of limited physical contact (e.g., placing a hand on the family member’s shoulder or providing a shoulder to cry on). Monitor the individual’s body language and if at all in doubt whether such contact would be well received, ask first.

- Realize that the individual may initially appear to be in shock or denial. Expect additional reactions, such as sadness, anger, guilt, or blame. Acknowledge emotions and allow them to be expressed without judgment.

- Do not ignore or dismiss suicidal or homicidal statements or threats. Investigate any such statements (often this will be facilitated by the involvement of mental health professionals) and if concerns persist, take appropriate action.

- Just before and during the notification process, try to assess if the survivors have any physical (e.g., severe heart disease) or psychological (e.g., major depression) risk factors, and assess their status after notification has been completed.

- If possible, write down your name and contact information in case the family wants further information at a later time. If the situation is not appropriate for providing your name and contact information, then consider how the family may be able to obtain additional information in the future (even months later).

- Do not try to “cheer-up” survivors by making statements such as “I know it hurts very much right now, but I know you will feel better within a short period of time.” Instead, allow them their grief. Do not encourage them to be strong or to cover up their emotions by saying “You need to be strong for your children; you don’t want them to see you crying, do you?” Feel free to express your own feelings and to demonstrate empathy, but do not state you know exactly how family members feel. Comments such as “I realize this must be extremely difficult for you” or “I can only begin to imagine how painful this must be to hear” can demonstrate empathy. Avoid statements such as “I know exactly what you are going through” (you can’t know this) or “You must be angry” (let the individual express his or her own feelings; don’t tell the person how to feel) or “Both my parents died when I was your age” (don’t compete with the survivor for sympathy). Provide whatever reassuring information you may be able to, such as “It appears your husband died immediately after the explosion. It is unlikely he was even aware of what happened and did not suf-
fer before he died.” However, do not use such information as an attempt to cheer up family members (e.g., “You should be happy, many people suffered painful burns or were trapped under rubble for an hour before they died. At least your husband didn’t experience that.”)

- Feel free to demonstrate that you are upset as well—it is fine to cry or become tearful. If you feel, though, that you are likely to become overwhelmed (e.g., sobbing or hysterical), then try to identify someone else to do the notification.
- After you have provided the information to the family and allowed adequate time for them to process the information, you may wish to ask questions to verify comprehension.
- Offer the family the opportunity to view the body of the deceased and to spend some time with their loved one. Before allowing the family to view the body, the health care team should prepare it for viewing by others. A member of the health care team should escort the family to the viewing and remain present, at least initially.
- Help families figure out what to do next. Offer to help them notify additional family members or close friends. Tell them what needs to be done regarding the disposition of the body. Check to see if they have a means to get home safely (if they have driven to the notification, they may not feel able to drive back safely), and inquire if they have someone they can be with when they return home.
- Help survivors identify potential sources of support within the community (e.g., member of the clergy, their pediatrician, family members, or close friends).
- Take care of yourself. Death notification can be very stressful to health care providers.”

**Counseling interventions according to age**

The general recommendations provided by the Pan American Health Organization for children and adolescent psychosocial care in a disaster situation can be found in the appendix. The chart describes the recommendations for parents and teachers for sleep disorders, excessive clinging, incontinence, regressive behaviors, school problems, anxiety, aggressiveness, rebellious, hostile and reckless behavior, pain and somatic complaints, and bereavement.

An understanding of how children may view death and adjust to loss is critical to providing psychosocial counseling and care. As described in *Pediatric Terrorism and Disaster Preparedness: A Resource for Pediatricians*, children’s understanding of death may be very different from that of adults. Children have had far less personal experience of loss and have accumulated less information about death. They can also have difficulty understanding what they have seen and what they are told unless the basic concepts related to death are explained to them. Adults will need to provide especially young children with both the basic facts about what happens to people after they die, as well as the concepts that help them to explain those facts. For example, young children may be told that after people have died, their body is buried in a cemetery or turned to ashes that can then be buried or scattered. Children can be very distressed by these facts unless they are helped to understand the concept that at the time of death, all life functions end completely and permanently—the body can no longer move, and the person is no longer able to feel pain. That is why it is okay to bury or cremate the body.

Children need to understand four concepts about death to comprehend what
death means and to adjust to a personal loss: irreversibility, finality, inevitability, and causality (Table 1). Most children will develop an understanding of these concepts between ages 5 and 7, but this varies widely among children of the same age or developmental level, based in part on their experience and what others have taught them. When faced with a personal loss, some children 2 years old or younger may demonstrate at least some comprehension of these concepts. Adults should not

<table>
<thead>
<tr>
<th>Concept</th>
<th>Example of incomplete understanding</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Irreversibility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death is seen as a permanent phenomenon from which there is no recovery or return.</td>
<td>Child expects the deceased to return, as if from a trip.</td>
<td>Failure to comprehend this concept prevents child from taking the first step in the mourning process, that of appreciating the permanence of the loss and the need to adjust ties to the deceased.</td>
</tr>
<tr>
<td><strong>Finality (Nonfunctionality)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death is seen as a state in which all life functions cease completely.</td>
<td>Child worries about a buried relative being in pain or trying to dig himself or herself out of the grave; child wishes to bury food with the deceased.</td>
<td>Can lead to preoccupation with physical suffering of the deceased and may impair readjustment; serves as the basis for many horror stories and films directed at children and youth (e.g., zombies, vampires, and other “living dead”).</td>
</tr>
<tr>
<td><strong>Inevitability (Universality)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death is seen as a natural phenomenon that no living being can escape indefinitely.</td>
<td>Child views significant individuals (i.e., self, parents) as immortal.</td>
<td>If child does not view death as inevitable, he or she is likely to view death as a punishment (either for actions or thoughts of the child or the deceased), leading to excessive guilt and shame.</td>
</tr>
<tr>
<td><strong>Causality</strong></td>
<td></td>
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<tr>
<td>A realistic understanding of the causes of death is developed.</td>
<td>Child who relies on magical thinking is apt to assume responsibility for death of a loved one by assuming bad thoughts or unrelated actions were causative.</td>
<td>Tends to lead to excessive guilt that is difficult for child to resolve.</td>
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</tbody>
</table>

underestimate the ability of young children to understand what death means if it is explained to them properly. Therefore, it is best to ask children what they understand about death, instead of assuming a level of comprehension based on their age. As children explain what they already understand, it will be possible to identify their misunderstandings and misinformation and to correct them accordingly.

When providing explanations to children, use simple and direct terms. Be sure to use the words “dead” or “died” instead of euphemisms that children may find confusing. If young children are told that the person who died is in “eternal sleep,” they may expect the deceased to later awaken and be afraid to go to sleep themselves. This description does little to help children understand death and may cause more confusion and distress.

Religious explanations can be shared with children of any age, but adults should appreciate that religious explanations are generally very abstract and therefore difficult for young children to comprehend. It is best to present both the facts about what happens to the physical body after death, as well as the religious beliefs that are held by the family. Even when children are given appropriate explanations, they still may misinterpret what they have been told. For example, some children who have been told that the body is placed in a casket worry about where the head has been placed. After explanations have been given to children, it is helpful to ask them to review what they now understand about the death.

It is also helpful for children to find their own unique way of saying goodbye to someone they have lost—this can be achieved through painting, planting and caring for a tree, praying, lighting a candle, or any other suitable expression. The permanence of the situation can be supported over time.

Children younger than 12 months
Focus the care of infants on the fulfillment of their basic needs, such as feeding, sleeping, and general care, and sheltering them during the caregiver’s difficult adaptation to the event. Appropriate nurturing care and developmental stimulation (e.g., singing, cuddling, playing) is desirable. Resume daily routines to the extent possible.

Preschool-age children
The best way to reduce the emotional impact of disaster is to try to keep the family together and the parents functioning well. In this way, children can get the support and care they need.

The most important thing for the emotional health of children who experience disaster situations is to feel loved, cared for, and protected by their parents or caregivers.

The intervention for preschool-age children depends on their symptoms:

- If they become passive and listless, provide them with a routine safe place, where they can feel emotionally connected and have suitable materials for drawing, playing, or other activities. Encourage them to draw people they would like to be with, put names to those people, create a story about the drawing, and make a poster where new elements can be added.
- If they feel scared, provide supportive opportunities for them to express their fears and emotions.
- If the child is having sleep disturbance (nightmares and or fear of being alone at night) try routine calming activities before bedtime, such as reading a comforting book or telling a hopeful story.
These disturbances are usually temporary and fluctuate in severity. It is important for parents to provide gentle structure, reassurance, and some flexibility in routines.

- Regressive behaviors (e.g., thumb-sucking, bed-wetting, and baby-talk) are common responses to stress. They provide some sort of comfort to the child, are not intentional, and usually are transitory. The best manner for parents to respond is to accept this as a measure of how distressed the child is by the situation and to gently encourage her/him to return to their developmental achievements. Parents should avoid criticism, mockery, or annoyance, and should reward developmentally appropriate behavior through praise.

- Give them all the information they need, without unnecessarily alarming them. Answer questions in a truthful but plain and simple way. Do not share descriptions of specifics of loss and trauma with them at this age as it may lead to further traumatization. If they do not understand what is going on and cannot discern their own feelings, help them understand what they feel through playing or drawing, especially if it is shared with parents or caregivers. Caregivers should also share some of their similar feelings and explain how they feel safer now. This helps the child to understand that their feelings are common responses and that they are not alone in having them.

- Children may attribute magical qualities to certain objects or situations (magical thinking) through their egocentric cognitive capacity. They may believe that seeing an object related to the emergency may cause the event to be repeated. Avoid exposing the children to the news media, especially TV. Images can be retraumatizing, and the children may not understand that the images shown are from a past discrete event rather than new disasters.

- Children separated from close relatives, even for a short period of time, may feel distressed, anxious, and irritable. It is important for parents to understand that this is also likely to be transient, and that they should try to spend more time together as a family, providing the children a safe space to express themselves.

School-age children
The emotional impact of disaster on children of school age is also strongly related to the adaptation of their caregivers. They comprehend the notion of good and bad, and as they develop, they can verbally express their feelings and emotions. However, disasters typically surpass the ability of many people to cope and it is common for children to feel confused and worried about their own reactions.

An appropriate response for school-age children is to provide them a safe space where they can share their experience and fears. A dialogue with caregivers can be very helpful, especially if the caregiver is adapting well.

School-age children frequently worry about their behavior during the disaster. They may feel responsible for not having done enough and may blame themselves. It is important to create conditions where they can express their feelings and emotions, and to reassure them that what happened was nobody’s fault (particularly in natural disasters), and especially not their fault. Children of all ages (and even adults) may worry that something they did or failed to do, or even just thought or wished about, may have caused or contributed to the disaster or the death of loved ones, even if there is no logical reason for such feelings. Children are naturally
rally reluctant to disclose such feelings of guilt, which may significantly impair their adjustment to the disaster.

When traumatic reminders trigger specific fears, it is important to help them identify and verbalize the setting and/or emotion that elicited those feelings. Although they may be able to understand what occurred, repeated graphic images of the disaster can trigger and exacerbate feelings of fear and anxiety. One way to minimize the impact of media exposure is to watch TV together and mutually share their emotions about the images and the event. Some children will repeatedly re-enact a traumatic situation with obsessive detail, cognitive distortions, and occasionally with an absence of specific information. Frequently the intensity of the emotions is so extreme that children may become overwhelmed. It is important to allow them to cry and express anger and sadness. If this occurs in the presence of supportive parents or caregivers, it can be quite therapeutic. If they are unable to verbally express themselves, art and play material can assist them.

Encourage continued socialization of children, but without making it burdensome. Plan structured activities for the differing developmental stages and interests. These activities are beneficial for children and for the community. For example, children can help with cleaning the school if it was affected or gathering food for those who had been displaced to shelters.

Provide additional supports, both at home and at school, to assist children in learning and meeting other academic demands.

Adolescents
Provide adolescents with a space to discuss the event and their initial and ongoing response to it. It can also be helpful for a reliable adult to share valid information with them.

Adolescents are frequently self-conscious about their emotions, especially fears generated by the traumatic event. Fears can sometimes create a sense of vulnerability and shame. It may be beneficial for them to share these feelings within a group of peers.

Adolescents may “act-out” what they cannot verbally express. Substance abuse, criminal behaviors, and sexual promiscuity are some possible behaviors. These pose a challenge for the parents and should be addressed by the family, school, and the community.

In addition, abrupt shifts in interpersonal relationships can occur during times of crisis. Changes in familial, peer, and other (teacher) relationships may occur. Provide a safe place for parents and adolescents to talk about these changes and how they affect them. Reflecting on abrupt losses or changes in relationships and how to adapt to these changes may result in a plan on how to redesign the family structure.

Typically adolescents place a high value on the sense of justice. This may lead certain individuals to a strong desire for revenge. Man-made disasters are the ideal situation for feelings of revenge to arise. It is important for adults to acknowledge these emotions discourage this kind of retaliatory behavior. Discuss the real consequences of following these emotions to discourage impulsive revenge.

Adolescents may also need a space to talk about the events, with freedom to ask all the questions they have. Adolescents should be invited to talk about their feelings, but should not be forced by parents to engage in discussions when they are not yet ready. They can also participate in family decisions and help in reconstruction tasks; being provided opportunities where they can help others may assist adolescents in coping with their own distress.

School-based interventions
Pediatricians should work with schools (and sites that provide daycare) in disaster planning as well as during the post disaster response because schools are often the best (and sometimes only) setting to deliver mental health services to children after a disaster. Getting children back to school as soon as possible encourages a more normal routine and provides access to emotional support from both teachers and peers. Abnormal grief reactions and mental health disorders such as PTSD are likely to emerge in the school setting. For example, intrusive thoughts and difficulty concentrating may interfere with academic performance and social adaptation. Therefore, school programs that deal with the consequences of trauma and the recovery process may be helpful. These programs should integrate efforts to identify and refer children in need of more intensive individual evaluation and treatment.

**Early intervention and crisis response for children and families** (from the *Pediatric Terrorism and Disaster Preparedness: A Resource for Pediatricians*, Foltin et al., 2006)

Unfortunately, there is no clear empirical evidence for the effectiveness of any crisis response intervention. In fact, the frequently used and previously heralded Critical Incident Stress Debriefing or Management (CISD or CISM) strategies have not demonstrated effectiveness, and in some studies they have proved detrimental. Indeed, it has been recommended that compulsory debriefing of victims of trauma should cease. However, it is possible that an alternative method of early crisis intervention may be helpful for assisting people who may be recently traumatized. The following recommendations and guidelines for early intervention strategies are based on evidence from research on the risk factors for PTSD as well as some intervention research. Thus, they provide an empirical foundation for appropriate and useful approaches to assist potentially traumatized individuals. Currently, there is no evidence that global intervention for all trauma survivors serves a function in preventing subsequent psychopathology. However, there is consensus that providing comfort, information, and support and meeting the immediate practical and emotional needs of affected individuals can help people cope with a highly stressful event. This intervention should be conceptualized as supportive and noninterventional but definitely not as a therapy or treatment. This suggestion recognizes that most people do not develop PTSD and other posttraumatic symptoms immediately. Instead, they usually will experience transient stress reactions that will abate with time. The goal of early intervention is to create a supportive (but not intrusive) relationship that will result in the exposed individual being open to followup, further assessment, and referral to treatment when necessary. Inherent in this early intervention is the recognition that interpretation or directive interventions are not to be provided. After assuring that basic necessities are available and are not a pressing concern, the basic principles of intervention should be followed. These principles should ensure that no harm is being done in the intervention process and hopefully prevent or reduce symptomatology and impairment.

- Interventions should be grounded in the basic principles of child development, and providers should be experienced in working with children of different ages and levels of development.
• Mental health providers should have collaborative relationships with community providers to ensure access and community support for children and families.
• Children and families should be assessed for risk factors and symptoms, and interventions should be crafted to address the findings.
• An essential objective is to improve parental attention and family cohesion through assessment, psychoeducation, and treatment, when necessary, to parents and primary caregivers.
• Providers should make concerted efforts to prevent social disruption and displacement.
• Providers should identify, assess, and attempt to ameliorate or remove children and families from the continued threat of danger.

Providers should have continued contact and monitor children for symptoms or impairment.

Handouts or flyers that describe trauma, what to expect, and where to get help should be made available. Individuals should be given an array of intervention options that may best meet their needs. The goal is not to maximize emotional processing of horrific events, as in exposure therapy, but rather to respond to the acute need that arises in many to share their experience, while at the same time respecting those who do not wish to discuss what happened.
How can pediatricians detect conditions intervene and help reduce the emotional impact of disaster on children and adolescents?

Pediatricians have a fundamental role in the assessment of the emotional impact of disasters on children and adolescents. By detecting conditions that can increase the emotional impact and by identifying the most vulnerable, pediatricians can advise families, teachers, and the community on ways to minimize the emotional consequences of the disaster.

The pediatrician is a very significant figure for parents because they have entrusted the care of their child to this physician. The pediatrician is also an important link in the child-family-school-community chain. Part of the pediatrician’s role is to encourage communication between families, schools, and leaders in the community, to develop a joint plan that aims to reduce or avoid long-term emotional consequences and return children to a sense of routine and security. The first aspect pediatricians should address is a plan for their own security and the security of their family. Lack of planning and intense worry about one’s own and family’s security will undermine the ability to assist others.

Pre-disaster intervention

Ensure that the emotional needs of children are adequately considered and addressed as part of the anticipatory planning of disasters.

Because the pediatrician understands the physical and emotional needs of children throughout their different developmental stages, the active engagement of pediatricians in all phases of planning is needed to create a plan that addresses the psychosocial aspects of children and families.

With this knowledge, one can advise parents, teachers, police officers, firefighters, and others on some of the basic elements needed to prevent or reduce the expected emotional impact on children, and to identify children at high risk for an intense and immediate emotional disturbance and chronic mental health problems.
Pediatricians can give advice on the emotional needs of children at each developmental stage, and can assist in community collaboration. One way to prepare the community is by giving talks, distributing leaflets or other informational material, and educating the local media.

A pediatrician can also assist in the planning for the placement of available resources and structure of the rescue teams in pediatric hospitals, shelters, and emergency rooms.

Pediatricians should also work together with school personnel in the preparation of programs aimed at early and ongoing detection of emotional disturbances among the students. It is important to train teachers and personnel in charge about the specific emotional needs and typical reactions to a disaster.

The pediatrician should talk with parents about the reactions they might expect from their children according to their developmental stage (see section III). Implementation of this kind of anticipatory planning is especially crucial in those communities considered to be at high risk for being exposed to earthquakes, hurricanes, floods, and other natural disasters.

**During the disaster**

Pediatricians should help community leaders identify the existing resources to deal with the disaster and make sure that those resources are distributed equitably. It is important to participate in disaster-related call centers and educate the mass media in order to educate broader segments of the population. It is also crucial to become integrated into an organized relief and recovery program. It should be kept in mind that children spend many hours at school, and disasters often occur while they are there. Hence, if teachers and school personnel are trained to identify the most frequent emotional manifestations of students and know how to deal with them, the school can provide an adequate place for children and adolescents to feel safe and confident enough to express their concerns and carry on activities appropriate for their age. This will likely reduce the emotional impact and its consequences.

**After the disaster**

It is important for pediatricians to be available for consultation to families, schools, and the community in recognizing the different long-term emotional reactions that appear among the childhood/adolescent population.

Once the event is over and the threat has abated, they should give emotional support and guidance to families, especially the parents. Consider referring parents for support when needed, since the parents are the main vehicle by which children recover. They should listen and advise parents on how to respond to their child’s emotional distress. Clarifying normal reactions and those reactions that are more concerning can be very helpful to parents. If intact, the pediatrician’s office should remain a safe place for children and families to feel comfortable and free to ask for guidance and support. It is ideal to have an adequate place where meetings with the whole family can be held. Encourage dialogue between parents and their children that can be modeled by the pediatrician.

The pediatrician should continue to provide emotional support and facilitate communication among family
members. He/she should help rebuild a normal routine so children can regain a sense of security. He/she should be alert to those children with special needs, e.g. those who have been direct witnesses of the disaster, children with previous diseases, or orphans. It is imperative to follow up on children in order to establish the need for specialist referral.

The role of the pediatrician also includes being an advisor to school personnel, helping to screen children for impairing symptoms, and being available for further assessment with treatment or referral of children who have more severe or chronic symptoms.

In addition to providing information that the observed emotional disturbance is transitory, the pediatrician should also counsel families, educators, and the media, that a certain percentage of children will develop long-term symptomatology and impairment benefiting from treatment.

The pediatrician should also be aware of the criteria for a child or adolescent referral to a mental health professional, a specialist, or community-based treatment. Many pediatricians believe it is their responsibility to screen for emotional distress and make referrals after trauma and disaster. Formal screening of all individual can be very helpful and is more suitable than informal screening or routine surveillance (http://massgeneral.org/schoolpsychiatry/checklists_table.asp).

The identification of mental health disturbance can be complicated by an individual’s reluctance to discuss symptoms, and ongoing fears for safety, and by shame and guilt associated with the trauma. It may be difficult for medical providers to inquire about symptoms since they may be affected by the disaster and are uncomfortable with the subject. Those who believe it is not their responsibility or lack suitable training or confidence can still provide suitable anticipatory guidance and counseling, and can identify those vulnerable individuals most at risk for persistent or severe emotional impact. In this regard, special attention should be paid to children who have been direct witnesses of terrorist attacks or slaughter or who have suffered significant losses.

**When should professional help be sought?**

In most cases, expressions of emotional impact are transient and children go progressively back to normal activities. However there are cases that require referral to a mental health professional.

Mental health professional intervention has the following goals:

- To offer the child a safe setting where he/she can talk about his/her feelings and emotions with respect to the situation he/she is undergoing.
- To prevent the symptoms from becoming chronic and interfering with everyday performance.
- To implement the needed measures to lessen the potential impact on the developing personality of the child.

Refer if the child presents with:

- Suicidal thoughts or suicidal ideation.
- Symptoms that persist for more than 1 to 3 months and interfere with everyday life.
- Aggressive behavior, threatening his/her own or other people’s life.
- Behavioral school problems that interfere with acceptable functioning.
• Persistent (longer than 1 month) withdrawal behavior that interferes with social life.
• Frequent nightmares that persist over time.
• Frequent outbursts of anger, annoyance, explosive behavior.
• Persistent (longer than 1 month) somatic complaints.
• Avoiding behavior or anxiety symptoms that interfere with everyday life.
• Alcohol or substance abuse.
• Preexisting problems and risk factors should be taken into special consideration, since traumatic situations can reactivate previous conflicts with overwhelming effects (Box 6).

Some communities lack a formal mental health system or are overwhelmed by the needs of the populace. In these instances, innovative community-based treatments can be effective. After a major flood and landslide in Venezuela, specialized treatments for parents and children were developed to address the significant prevalence of post-traumatic stress disorder symptoms. This included summer camps for children to address their ongoing fears and other symptoms, and it also allowed caregivers to receive treatment concurrently.

The pediatrician can also help mental health professionals by describing local idioms for emotional symptoms and cultural patterns of distress as well as local stigma associated with mental disorder treatment. The pediatrician should inform parents that many individuals have chronic emotional disturbance after disaster, but that treatment is helpful. The pediatrician can also be helpful to mental health professionals by identifying suitable volunteers in the community. Mature individuals who are motivated, adapting well, and trusted within the community can be trained by mental health professionals to help implement community-based programs.

**Box 6. Children with high risk for poor emotional outcome**

- Wounded children
- Children separated from parents for an extended period of time
- Children with previous illnesses, physical or mental
- Children with poor family emotional support
- Children whose parents have recently divorced
- Children who have been direct witnesses of terrorist attacks or slaughter, or thought they would not survive
- Children with a history of child abuse
SUMMARY

Disasters place affected populations in great danger. Only in recent years have we recognized the importance of emotional impact and its short, median, and long-term consequences.

Children and adolescents are an especially vulnerable group, since the reaction to disaster in these age groups depends on their psychosocial developmental stage, individual characteristics, degree of emotional and affective dependency on adults, and previous experiences.

In the aftermath of a disaster, an emotional response is expected in the pediatric population that can be considered a “normal reaction to an abnormal situation.” However, if the response becomes very intense or persistent, or the child has an increased vulnerability, more immediate specific support is necessary.

The role of the pediatrician as part of the child-family-school-community chain is crucial, for he/she knows the physical and emotional needs of children in each developmental stage and represents an important source of information, support and help for the community, school, families, and children.

Acknowledging and addressing emotional disturbances in the childhood population at an early stage is, to a great extent, the most effective way to prevent persistent and long-term disorders.


http://massgeneral.org/schoolpsychiatry/checklists_table.asp


Lubit R, Tovine D, Defrancisci L, Eth S. Impact of trauma on
SUGGESTED BIBLIOGRAPHY


Case resolution

**Case 1**
It is important to convey the message that emotional manifestations following situations of disaster are the expected adaptive reactions to a chaotic unexpected situation.

The emotional impact on children is related to a great extent to parent’s or caregiver’s reactions, so it is essential to first listen to them and give them support to minimize the adults’ distress.

It is important for parents to know the potential emotional reactions of their children, according to their developmental stage. In the same way, it is important to identify the difference between an expected reaction and one that requires attention.

**Case 2**
Children spend a great part of the day at school in contact with their teachers. Therefore, it is essential for teachers to be familiar with the different emotional needs of their students according to their specific developmental stage. Also, teachers need to know the different reactions and symptoms that may develop among their students.

It is important that the pediatrician work together with the school to implement programs aimed at early detection of emotional disturbances.

The role of the pediatrician as an advisor for school personnel is crucial, and he or she should be available whenever required for the assessment of certain students.
MODULE REVIEW

SECTION I - EMOTIONAL VULNERABILITY IN CHILDREN AND ADOLESCENTS IN DISASTER SITUATIONS

1. What individual conditions influence vulnerability in children?
2. What factors influence the emotional impact of disasters on children?
3. What are the coping resources families can count on to deal with a situation of disaster?

SECTION II - CHILDREN'S EMOTIONAL RESPONSE TO DISASTER

1. What are the most frequent emotional disturbances that occur among the childhood population exposed to disaster?
2. What are the characteristics of post-traumatic stress disorder?
3. What are the major symptoms in depressive disorders?

SECTION III - DEVELOPMENTAL STAGE SPECIFIC INTERVENTIONS

1. How should a pediatrician notify the family about a death?
2. What are the common examples of incomplete understanding of death by children?
3. What is the goal of early intervention for children and families?

SECTION IV - PREVENTION AND DETECTION OF MENTAL HEALTH PROBLEMS

1. What is the role of the pediatrician in helping to reduce the emotional impact on the childhood population?
2. How should the pediatrician intervene before a disaster takes place?
3. What is the role of the pediatrician during the disaster?
4. What contributions can the pediatrician make after the disaster?
Summary of the main psychological reactions of children and adolescents in disaster and emergency situations

<table>
<thead>
<tr>
<th>Age group</th>
<th>Reactions within the first 72 hours</th>
<th>Reactions within the first month</th>
<th>Reactions during the second and third months</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2 years</td>
<td>• Agitated state  &lt;br&gt;• Frequent shouting and crying  &lt;br&gt;• Excessive clinging to parents (cannot bear separation)  &lt;br&gt;• Cannot fall asleep or often wake up  &lt;br&gt;• Overreact to any kind of stimuli and it is difficult to reassure them</td>
<td>• Sleep disorders  &lt;br&gt;• Loss of appetite  &lt;br&gt;• Excessive clinging to parents  &lt;br&gt;• Apathy  &lt;br&gt;• Regressive behavior</td>
<td>• Sleep disturbance  &lt;br&gt;• Greater tolerance to physical separation  &lt;br&gt;• Unjustified crying</td>
</tr>
<tr>
<td>3 - 5 years</td>
<td>• Behavioral changes, passivity, irritability, restlessness  &lt;br&gt;• Excessive fear of any stimuli, especially those reminiscent of the event  &lt;br&gt;• Spatial disorientation (cannot tell where they are)  &lt;br&gt;• Sleep disturbances: insomnia, waking up in a state of anxiety, etc.</td>
<td>• Regressive behavior: bed-wetting, baby talk, thumb-sucking  &lt;br&gt;• Cannot bear being alone  &lt;br&gt;• Appetite loss or increase  &lt;br&gt;• Sleep disorders  &lt;br&gt;• Loss of powers of speech or stammering  &lt;br&gt;• Specific fears: of real people or situations (animals or darkness) or of imaginary ones (witches, etc.)</td>
<td>• School or child care center refusal  &lt;br&gt;• Headaches and bodily pain  &lt;br&gt;• Food refusal or excessive eating  &lt;br&gt;• Repetitive play enactment of the traumatic event</td>
</tr>
<tr>
<td>6 - 11 years</td>
<td>• Behavioral changes: passivity  &lt;br&gt;• Aggressiveness, irritability  &lt;br&gt;• Confusion (appear puzzled) and disorientation (cannot tell date, place, etc.)  &lt;br&gt;• Frequent crying  &lt;br&gt;• Regressive behavior  &lt;br&gt;• Language impairments</td>
<td>• Unjustified fear  &lt;br&gt;• Difficulty keeping still  &lt;br&gt;• Difficulty focusing attention  &lt;br&gt;• Headaches and other somatic complaints  &lt;br&gt;• Repetitive play enactment of the traumatic event</td>
<td>• Difficulty concentrating at school  &lt;br&gt;• School refusal  &lt;br&gt;• Feel guilty or assume the disaster is a consequence of something they have done or thought  &lt;br&gt;• Appear withdrawn or shy  &lt;br&gt;• Repetitive play enactment of the traumatic event</td>
</tr>
</tbody>
</table>
### General recommendations for children and adolescent psychosocial care in a disaster situation

<table>
<thead>
<tr>
<th>Observed disturbance</th>
<th>Recommendations for parents</th>
<th>Recommendations for teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sleep disorders</strong></td>
<td>• Reassure them&lt;br&gt;• Be firm about sleeping time&lt;br&gt;• Stay with them for a while&lt;br&gt;• Leave a nightlight on&lt;br&gt;• If they wake up fully and are scared (nightmare), reassure them; if they recall the event the following day, talk about the cause of their fears. If they are not fully awaken (night terror), do not wake them, since they will not recall the event the following day</td>
<td>• Identify the problem (for instance, if you notice the child is exhausted)</td>
</tr>
<tr>
<td><strong>Excessive clinging</strong></td>
<td>• Reassure them&lt;br&gt;• Encourage physical contact and cuddle them&lt;br&gt;• In case of separation, tell them where you are going and when you are coming back. Have somebody stay with them</td>
<td>• Allow parents to be in the classroom for some time, reducing it gradually</td>
</tr>
<tr>
<td><strong>Incontinence</strong></td>
<td>• Avoid punishments and mockery&lt;br&gt;• Change their clothes and reassure them&lt;br&gt;• Limit liquids at night&lt;br&gt;• Take them to the bathroom before they go to bed and during the night&lt;br&gt;• Show them how pleased you are when they do not wet the bed (tell them so; register the days they have not wet the bed in a calendar, etc.)&lt;br&gt;• Leave a nightlight on</td>
<td>• Do not allow mockery or rejection from classmates&lt;br&gt;• Resume school activities as soon as possible</td>
</tr>
<tr>
<td><strong>Other regressive behaviors</strong></td>
<td>• Do not punish them (ignore these behaviors)&lt;br&gt;• Make them focus on something else</td>
<td>• Make them focus on something else&lt;br&gt;• Ignore these behaviors</td>
</tr>
<tr>
<td>Observed disturbance</td>
<td>Recommendations for parents</td>
<td>Recommendations for teachers</td>
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<td>----------------------</td>
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</tr>
</tbody>
</table>
| **School problems**  | • Seek rapid school reintegration  
• Do not punish them for their faults; instead, reward any progress  
• Seek a return to normal routines at home  
• Be firm about a reasonable study schedule | • Rapid school reintegration  
• Partial parental presence (in the case of the youngest children)  
• Special support in case of poor performance: sit the child in the first row; provide individualized attention at the end of school-day, etc.  
• Encourage participation  
• Reward achievements  
• Prevent discrimination |
| **Anxiety**          | • Reassure them  
• Do not transmit to them adults’ anxiety  
• Give clear and honest explanations about the past and current situation (avoid making assumptions about an uncertain future)  
• Explore management strategies with them (breathing techniques, physical activity, etc.) | • Bear in mind that anxiety interferes with attention and concentration and causes restlessness  
• Reward positive behaviors: staying seated, following instructions, etc.  
• Make periodic evaluations of achievements with them (acknowledgment and reinforcement of positive behaviors) and ignore negative behaviors |
| **Aggressiveness**   | • Help them face fears gradually; be with them  
• Set an example as regards self-control  
• Do not use either corporal or verbal punishment; the best punishment is indifference or a neutral attitude (still lovingly)  
• Make it clear that aggression to others shall not be allowed  
• Declare a truce: ignore the aggression while demanding isolation in a supervised place for a short time—“until you are able to control yourself”  
• Let them know what the desirable and expected behavior is  
• Encourage channeling of excessive energy, anxiety, and anger through nonharmful strategies  
• Reward self-control achievements (hugs, picture cards, stickers, etc.) | • Do not allow aggressive behaviors  
• Declare a truce  
• Explain what the desirable and expected behavior is  
• Reward achievements  
• Punish through indifference |
| **Rebellious, hostile, and reckless behavior** | • Be patient  
• Be firm and object to unacceptable behaviors  
• Set clear rules in the family environment  
• Encourage communication | • Behavior model  
• Consider possible external assistance for the family |
<table>
<thead>
<tr>
<th>Observed disturbance</th>
<th>Recommendations for parents</th>
<th>Recommendations for teachers</th>
</tr>
</thead>
</table>
| Pain and somatic complaints | • Rule out any medical condition; if necessary, resort to health services  
  • Establish the relationship between what happens and the symptoms  
  • Do not allow manipulation through symptoms | • Warn parents and facilitate medical aid |
| Bereavement | • Let them perceive their own sadness  
  • Let them express their feelings and memories freely (sadness, anger, guilt) and talk about it in the family group  
  • Provide company and manifest affection  
  • Do not conceal reality  
  • Do not encourage denial; talk about losses and their permanent nature, despite which it is necessary to “carry on” and try to return to normal life as soon as possible, including individual and collective social activities  
  • Allow their participation in funeral rites (burial, religious services in case of death, etc.)  
  • Counteract possible feelings of anger and guilt explaining the real circumstances of the loss (or death)  
  • Allow adolescents to deal with mourning before they assume new responsibilities | • Inform classmates before the child starts attending classes. Briefly explain what normal reactions the child will have  
  • Provide emotional support  
  • Facilitate spaces to talk with the child individually, but do not focus all your attention on him/her  
  • Encourage participation in regular educational and recreational activities  
  • Check the child’s evolution and identify red flags (growing sadness, death or suicidal thoughts, etc.)  
  • Contact parents and coordinate actions |

From Pan American Health Organization, Practical guide of mental health in disaster situations. Washington DC, 2006
Toxic Exposures
Kathy L. Leham-Huskamp | William J. Keenan | Anthony J. Scalzo
INTRODUCTION

The first large-scale production of chemical and biological weapons occurred during the 20th century. World War I introduced the use of toxic gases such as chlorine, cyanide, and arsine as a means of chemical warfare. With recent events, such as the airplane attacks on the World Trade Center in New York City, people have become increasingly fearful of potential large-scale terrorist attacks. Consequently, there has been a heightened interest in disaster preparedness especially involving chemical and biological agents. The U.S. Federal Emergency Management Agency (FEMA) recommends an "all hazards" approach to emergency planning. This means creating a simultaneous plan for terrorist events as well as for the more likely public health emergencies, such as earthquakes, floods, unintentional hazardous incidents, and infectious outbreaks. Most large-scale hazardous exposures are determined by the type of major industries that exist and/or the susceptibility to different types of natural disasters in a given area. For example, in 1984 one of the greatest man-made disasters of all times occurred in Bhopal, India when a Union Carbide pesticide plant released tons of methylisocyanate gas over a populated area, killing scores of thousands and injuring well over 250,000 individuals. This module provides universal guidelines for interventions during toxicological disasters.
OBJECTIVES

- Understand the increased vulnerability of children exposed to toxins.
- Analyze the causes of the increased vulnerability of children to toxins.

Differences between children and adults place children at increased risk for exposure in many toxicological disasters (Box 1). Shorter stature can make children more vulnerable than adults. Many chemical agents are more dense or heavier than air and consequently exist in higher concentrations closer to the ground. The same principle applies to nuclear contamination. A shorter person will be exposed to a higher concentration of chemicals and radiation simply by being closer to the ground.

Children also have a larger skin surface area to body mass ratio than adults. This increases their risk of absorption of toxins through the skin. A larger skin area to body mass ratio together with less subcutaneous fat places a child at higher risk for hypothermia with decontamination. A child’s skin has less keratinization, allowing corrosives to cause greater injury. Children also have higher minute ventilation per body mass. Therefore, pediatric exposures to aerosolized or gaseous toxins will be more extensive than with adults.

Children also have a decreased fluid reserve compared with adults and are at increased risk for dehydration with repetitive vomiting or diarrhea associated with toxic exposures or food-born illness. In addition, immature motor skills may make it less likely that the children will remove themselves from a dangerous situation.

BOX 1. Factors increasing children’s vulnerability in toxicological disasters

- Shorter stature
- Larger skin surface area to body mass ratio
- Skin with less keratinization
- Higher minute ventilation
- Decreased fluid reserve
- Immature motor skills
RESPONSE IN TOXICOLOGICAL DISASTER SITUATIONS

OBJECTIVES
- Identify the basic goals of toxicological disaster preparedness.
- Delineate the priorities of disaster scene staging and patient management in the event of an incident involving hazardous materials.
- Define a hazardous material.
- List the factors to be considered in the planning of and response to a toxicological disaster.

Toxicological disaster preparedness
As in any type of disaster, in events involving a hazardous material, prior preparedness is critical to minimize the effects on victims, rescuers, and other emergency personnel. In addition, it is essential to take the measures needed to avoid toxic contamination in non-exposed sectors of the community.

Bear in mind that various toxins can be involved in disasters and their effects vary. Rapid identification is critical to take appropriate measures in a timely manner.

Although community education regarding disasters is always an important issue of prior preparedness, in toxicological disasters this holds even more importance. In Box 2 are listed the basic goals of toxicological disaster preparedness.

Priorities in response to a toxic disaster scene
The first goal in the management of any type of disaster is to enhance the safety of the medical and rescue personnel while saving the greatest number of lives possible. To fulfill this goal, some universal principles apply to the management of any type of disaster. First, a chain of command must be established. An incident commander will need to oversee the scene and establish contact with a nearby base hospital. In hazardous materials incidents, a medical toxicologist, if available, should be designated as medical coordinator of the command post (see Module 3).
Contact the regional Poison Control Center to participate in the response. The chain of command must be strictly honored by all first responders.

The next task will be to set up appropriate zones for the management of the disaster (Box 3). The type of disaster will determine what zones are needed. The hot zone is the primary zone and essentially is the disaster site. This zone represents the area of continued danger, such as ongoing fires, falling debris, or exposure to hazardous materials. Mark off the perimeter of the hot zone with tape or rope if available. The incident commander will decide who is allowed into the hot zone. In general, no medical treatment should be given in the hot zone. If needed, set up a decontamination or warm zone just outside the perimeter of the hot zone. Also, mark off the perimeter of this zone with tape or rope. The decontamination zone represents an area of hazardous materials contamination. In this zone, patients can be stabilized and decontaminated. Ideally, this zone should be upwind, uphill, and/or upstream from the hot zone.

The next zone is the support zone or cold zone. This zone is located beyond the decontamination zone. It should contain no threat of secondary contamination to equipment, victims, or personnel. It is the area of definitive patient treatment and triage. The support zone typically houses the incident command post. No one from the general public or media should be allowed into any of these zones.

A key point in disaster scene management is the prevention of unauthorized entry and exit between zones. In large-scale disasters, the capacity for policing of these zones by local authorities will likely be exceeded and the uniformed armed services or National Guard forces will be required to maintain security.

If any disaster scene is suspected to involve hazardous materials (HAZMAT), verify the release and identify the toxin as rapidly as possible. HAZMAT is defined as any material that can cause harm to people, property, or the environment. Release of hazardous materials can include a large number of toxins. Mobilize adequate resources of trained personnel and appropriate equipment as quickly as possible. Upon the first suspicion of a hazardous material incident, rescue workers should call for extra help, specifically a HAZMAT response team if available. A hazardous materials incident will require all 3 zones (hot, decontamination, and support).

Emergency medical service (EMS) personnel should guide their planning using 6 important principles:

**Box 3. Disaster scene staging**

- Hot zone
  - Possible ongoing exposure
  - Full protective gear
  - Possible initial triage
- Decontamination zone (Scene and/or hospital)
  - Contaminated clothing removed
  - Flushing/washing
  - Thermal protection of children
- Support zone
  - Examination
  - Stabilization
  - Triage

No one from the general public or media should be allowed in any of the zones.

If any disaster scene is suspected to involve hazardous materials, verify the release and identify the toxin as rapidly as possible.
• The number of victims with medical problems will be potentially overwhelming
• The number of individuals (the “walking and worried well”) will likely exceed those with true injuries
• The onset of symptoms and signs may be precipitous (e.g., Bhopal or Tokyo sarin attacks)
• The onset of signs and symptoms may be delayed (e.g., phosgene gas)
• Multiple toxins may be involved in a single incident
• The victims may be EMS personnel themselves if not properly protected or unexpected events occur (e.g., World Trade Towers terrorist event on 9/11)
PERSONAL PROTECTIVE EQUIPMENT

OBJECTIVES

- Describe the different types of rescue personal protective equipment.
- Recognize the different levels of protection provided by various equipments.
- Know the initial management in radiation disasters.
- Consider climatic and geographical factors in the disaster scene.
- Describe the steps to be completed after the use of protective equipments.

Levels of protection for personal protective equipment

HAZMAT incidents require personal protective equipment (PPE). The US Environmental Protection Agency (EPA) has designated 4 levels of protection for PPE (Table 1 and Figure 1). Level A is the highest and provides respiratory, skin and vapor protection. This level requires the healthcare worker to wear a self-contained breathing apparatus (SCBA) underneath the suit. Some refer to this suit as a powered air purifying respirator (PAPR). Level B provides the highest level of respiratory protection but less skin protection and no vapor protection. Level C equipment has the same level of skin protection as Level B, but has lower respiratory protection. Level D is equivalent to a regular healthcare worker uniform, which is inappropriate in a hazardous material incident. PPE is often bulky and cumbersome making it difficult not only to handle patients but also to perform already challenging procedures such as venipuncture on children. Level A suits with SCBA can only protect ventilation for approximately 20 minutes because of the amount of air in each suit’s oxygen tank.

Wearing PPE requires special training. A rescue worker who has not had adequate training with PPE should not use it in a disaster scenario. The level of PPE required in each zone will be decided by the incident commander and medical coordinator.

In the case of radiation disasters, first responders should cautiously approach the scene, preferably from uphill and upwind from the site. A full face mask with a high efficiency particulate air (HEPA) filter should ideally be worn. If this is not available, personnel can breathe through a wet cloth or handkerchief. Rescue personnel should wear splash-proof clothing. Gloves and socks should be tucked under their clothes. All seams (neck, arm cuffs, etc.)

<table>
<thead>
<tr>
<th>Level</th>
<th>Degree of protection</th>
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<tbody>
<tr>
<td>A</td>
<td>Airway, including vapor, skin</td>
</tr>
<tr>
<td>B</td>
<td>Airway, skin (less)</td>
</tr>
<tr>
<td>C</td>
<td>Airway (less); skin (same as B)</td>
</tr>
<tr>
<td>D</td>
<td>No special protection</td>
</tr>
</tbody>
</table>

A rescue worker who has not had adequate training with PPE should not use it in a disaster scenario.
should be securely taped. A second pair of gloves should be worn over the first. These gloves can be easily removed and replaced. Water-proof shoe covers are worn over shoes. If available, workers should wear clip-on radiation dosimeters on the outside of their clothing where they can be easily read.

Cover all radiation measurement devices with plastic bags before entering a contaminated zone. The collection of radioactive dust following a radiation disaster must be recognized as a significant contamination hazard. Rescuers should not smoke, eat, or drink at the site. First responders are often susceptible to heat exhaustion. Provide water only in closed containers.

After any toxic/radioactive exposure, first responders should clean all nondisposable gear with a 5% hypochlorite solution (1 part household bleach to 9 parts water). Remove protective clothing, bag it, and discard it in a waste container labeled as “toxic waste.” All personnel should then wash with copious amounts of soap and water.

In areas that pose no risk of secondary contamination, follow universal contact precautions (gloves and face mask).
Whether a patient should be stabilized prior to decontamination depends on the nature of the toxic exposure, the needs of the patient, and the risks of possible exposure to personnel. Prioritization for treatment of any victim of toxic injury, especially children, begins with the ABCs of Airway, Breathing and Circulation.

A key concept is: Treat the patient first, not the poison.

The assessment and establishment of a patent Airway always is the first step. Adequate Breathing and ventilation must be assured (place patient in fresh air, give supplemental oxygen and/or administer positive pressure ventilatory support as indicated). Adequacy of Circulation can be assessed by noting the color, capillary refill, pulse and blood pressure (see Module 4, Pediatric Trauma). Once the airway, breathing, and circulation are established the patient can undergo decontamination procedures. Perform a complete physical examination with close attention to any breath or skin odors that may aid in the patient’s diagnosis. In the hospital setting, obtain basic laboratory studies, such as an arterial or venous blood gas, electrolytes, blood urea nitrogen, and creatinine, if feasible or practical. Clinical manifestations from toxic exposures may vary considerably. Whether the child presents as a “classic case” or as a partial toxic syndrome, the severity of the exposure and resultant disease cannot be dismissed or downplayed. Acknowledge possible delayed symptomatology and plan a suitable follow-up.

With ingested chemicals, avoid inducing emesis as this can aggravate the injury. Instead, encourage conscious patients to drink 4 to 8 ounces of water. Send patients with toxic ingestions immediately to a medical facility. Vomitus potentially containing chemicals is considered toxic. When vomiting has occurred, quickly wipe up the vomitus with towels and then double bag the towels. Provide nauseated patients with ingestions disposable bags to collect possible vomitus.

Decontamination
Decontamination is necessary in any disaster in which a toxic exposure is suspected. The goal of decontamination is to prevent further patient exposure and to prevent contamination of the staff. Assess all stable
patients for the need of decontamination prior to further examination, triage, or treatment. Decontamination is usually more important with chemical and radioactive exposures than with biologic exposures.

Victims in whom toxic exposure has been limited to a gas or vapor and who have no local skin or eye irritation and no condensation of gas on their clothing are not likely to cause secondary contamination. These circumstances allow selected patients to proceed directly to the support zone. In all other circumstances, once a victim is stabilized, decontamination should occur immediately. In general, it is not recommended to send a critically ill patient to the hospital prior to decontamination because the patient will have to undergo decontamination before entering the hospital. In addition, the contaminated patient poses risk of secondary contamination to healthcare workers, emergency equipment, and the transport vehicle. If the contaminated patient is transported, transport personnel should wear protective clothing and the equipment in the vehicle should be protected from contamination. Notify the receiving hospital that a patient who requires decontamination will be arriving. Establish the hospital-based decontamination area before such a patient arrives. In the hospital-level planning, account for patients who could arrive from the disaster scene on foot or in a private vehicle and will also require decontamination.

In the decontamination zone, divide victims into 2 groups: those who can remove their own clothing and those who require assistance. Remove and double bag all clothing and personal belongings. Place items slowly and carefully in small bags. This is especially important when handling clothes with radioactive dust. Label bags with the patient’s name, address, and phone number. In some disasters, patients are considered crime victims. In these cases, clear documentation and preservation of evidence are necessary.

Moving from head to toe, flush the skin and hair with water for 3 to 5 minutes, avoiding getting water into the airways or eyes. Flush irritated eyes with water or saline for at least 5 minutes. Remove contact lenses when present. Wash all skin areas with extra attention paid to skin folds, the axillae, and genital area. Use a mild soap to help remove oily contaminants. If there are large number of victims, consider the use of communal decontamination showers. Children are more susceptible to hypothermic stress when undergoing decontamination. If possible, use lukewarm water when flushing a child’s skin, dry promptly, and then swaddle warmly. When possible, drain water from decontamination into plastic containers that are labeled as “toxic waste.” With large-scale disasters, however, this becomes of less priority. A decontamination sequence is displayed in Box 4.

**Box 4. Sample decontamination sequence**

- Clothes removed, double bagged, labeled
- Complete body rinse
- Thermal stress protection for children
- Proper disposal of contaminated water
Emergency responders and medical personnel should prepare for the management of natural disasters that are most prevalent in their community. Natural disasters, however, can lead to secondary toxic exposures. For example, in July 2007 an earthquake measuring 6.6 on the Richter scale occurred in Northern Japan that resulted in 317 gallons of radioactive water leaking from a nuclear power plant into the Sea of Japan. Any force of nature that disrupts the soil and causes structural damage to surrounding buildings can result in toxic release. Homes, for example, can have natural gas leaks, electrical fires, and sewage line damage. This can lead to secondary exposures and injuries. Damage to area industries can lead to toxin exposures affecting larger numbers of people. Healthcare workers should be vigilant in disaster situations for clustering of symptoms that could suggest an ongoing exposure in the area.

Earthquakes and volcanic eruptions

Most earthquake fatalities are due to physical injuries, but the medical staff must be alert to signs and symptoms of secondary toxin exposures. Aftershocks should be expected with earthquakes and can lead to further damage and injuries. The majority of deaths from volcanoes are secondary to ash fall, which causes immediate suffocation. The ash mixes with mucus, forming plugs in larger airways. Survivors may complain of cough, wheeze, eye irritation, blisters on the skin, and muscle weakness. Volcanic eruptions release large amounts of gas that contain carbon monoxide, sulfur dioxide, methane, hydrogen sulfide, and hydrogen fluoride. Most of these gases...
Fires
Fires are extremely common after any natural disaster. Most deaths are caused by smoke inhalation. Numerous combustion products (carbon monoxide, hydrogen cyanide, ammonia, chlorine, phosgene, etc.) are released in a fire. The products released are often difficult to predict and depend on what type of material is burning. Smoke inhalation victims are at increased risk for tracheobronchial injuries that lead to increased airway resistance and bronchospasm. Consider intubation in patients with soot surrounding their mouths and nares, voice changes, stridor, or wheezing. Widespread pulmonary changes usually take up to 24 hours to become evident on chest radiography. An arterial blood gas sample, if available, will measure the patient’s carboxyhemoglobin level. If this is elevated, the patient is at increased risk for airway problems, so consider endotracheal intubation for airway protection. Also, quickly remove soot from the patient’s skin and eyes.

Common toxins in natural disasters
Carbon monoxide
Carbon monoxide poisoning is frequently seen after any type of natural disaster. Faulty or insufficient exhaust systems with the use of damaged furnaces, generators, camp stoves, or wood fires can be a prevalent hazard following an acute disaster. Since carbon monoxide is colorless and odorless, patients do not realize that they are being exposed. Standard universal precautions applicable to all patients should be used. Victims will not exhale carbon monoxide but carbon dioxide, so there is no risk of secondary contamination. Symptoms of carbon monoxide exposure vary from fatigue to total loss of consciousness (based on seriousness of exposure). They include confusion, headache, nausea, dizziness, flushed skin, especially on the face. Carbon monoxide binds to hemoglobin, creating carboxyhemoglobin. Carboxyhemoglobin does not readily release oxygen when compared with normal oxyhemoglobin. This results in tissue and cellular hypoxia, in spite of a red skin color. Consequently, in severe exposures patients may lose consciousness secondary to hypoxia and if not removed from the exposure will eventually die. When carbon monoxide poisoning is suspected, the most important initial treatment is removing the patient from the exposure and allowing him or her to breathe uncontaminated air. Administer supplemental oxygen via face mask, if available. Once in the hospital, certain laboratory tests may be useful. Measuring carboxyhemoglobin leads to a definitive diagnosis. Hemoglobin/hematocrit values can be used to detect underlying anemia, which can complicate therapy. Remember that peripheral saturation (pulse oximetry) gives a falsely normal result, since COHb has a light spectrum quite similar to oxyhemoglobin. Hyperbaric oxygen chambers have been used with severe exposures but are extremely limited in availability and probably will not be of much use in disaster situations. These, if available, remove carbon monoxide more rapidly. (Carbon monoxide half life in room air is 330 minutes and in hyperbaric oxygen chambers, 20 minutes.)

Cyanide
Cyanide has an additive effect with carbon monoxide. Cyanide is released from combustion of plastics, wool, silk, nylon, synthetic rubber, paper, and melamine resins. Consider cyanide exposure if synthetic materials are
involved in the fire or in patients with carbon monoxide poisoning and metabolic acidosis. Cyanide has strong affinity for ferric iron and causes cellular hypoxia, with metabolic acidosis and increased lactate production. This is caused by disruption of mitochondrial oxidative metabolism, and affects all tissues, particularly those most metabolically active, such as brain and heart. Early findings include tachypnea and hyperpnea, tachycardia, flushing, dizziness, headache, nausea and vomits. More severe exposures are associated with CNS depression, coma and seizures. Respiratory depression can occur.

Usually the patients present with severe dyspnea without cyanosis, even with bright red skin (due to lack of peripheral use of oxygen).

Recommendations for on site management include decontamination of victims, particularly those exposed to the liquid agent, including removal of wet clothes and skin washing. Administer 100% oxygen supplementation and respiratory support as needed. Give antiepileptic agents, such as benzodiazepines, for seizures, and crystalloid infusion if the victim is hemodynamically unstable.

After arrival to the hospital, certain laboratory tests may be useful in the management of these patients. Laboratory abnormalities include severe metabolic acidosis, with a high anion gap due to increased levels of lactate.

There are specific therapeutic measures available for cyanide poisoning.

A methemoglobin-forming agent, such as inhaled amyl nitrate, can be used initially in severely affected patients to dissociate cyanide from cytochrome oxidase. Caution is required, since this agent can cause hypotension and overproduction of methemoglobin, thus compromising oxygen transport capacity. On the other side, it has the advantage of being easy and quick to administer.

Sodium thiosulfate is also believed to be efficacious and safer. It can be used when diagnosis is still uncertain, particularly when smoke inhalation is involved, with likely concomitant lung injury and carbon monoxide poisoning.

Confirmed cyanide poisoning can also be treated with hydroxicobalamin. This agent is safer than nitrites. While recovery is rapid if cyanide poisoning is well and timely treated, without proper management, it can cause rapid death.

Poisons

Animal displacement after a large-scale natural disaster can also lead to unexpected, secondary toxin exposures. Be aware of what type of poisonous animals are prevalent in the community. Snakes are a particular problem and rescue and medical staff should be knowledgeable about treatment of such problems. In the past, incision of the bite, putting ice on the wound, and placing a tourniquet was recommended. Currently, none of these recommendations are in place. Instead, wash the bite with soap and water, immobilize the extremity, and keep it below the level of the heart. Then transfer the patient to the hospital as fast as possible. If the bite occurred over 30 minutes ago, then wrap a bandage around the extremity 5 to 10 cm above the wound. The bandage should be loose and a finger should be able to be easily placed under it. Approximately 30% of snake bites contain little or no venom. Ideally, the patient is observed for signs and symptoms of poisoning in a setting in which antivenom is immediately available. Administer antivenom upon signs of patient distress.
The signs and symptoms of a chemical exposure generally appear fairly quickly and lead to the ready identification of a hot zone. When the number of symptomatic individuals is limited, the tasks being performed during or shortly before the onset of illness may be the critical clue in determining the toxic exposure. Certain activities are likely to use specific chemicals and the identification of the victim's activity around the time of illness onset can aid in the generation of a list of possible chemical exposures. Sources of a wide array of chemical exposures are listed in Tables 3 and 4.

Matching a constellation of signs and symptoms with an associated syndrome can assist in the identification of the specific chemical exposure. Disaster scene responders should have proper resources.
available for chemical identification. If a Poison Control Center can be contacted, its personnel will be able to aid in exposure identification and subsequent treatment. Otherwise, provisions for other informational support will be required. For example, in the United States other sources such as Chemtrec (a HAZMAT communication center) can be contacted 24 hours per day by telephone or Internet. The Internet is an extremely valuable tool in times of uncertainty (see Suggested Reading for additional website resources). Refer to the Appendix –Chemical Glossary– for further details regarding specific chemicals and their treatments. As an example, a relatively common chemical exposure is discussed below.

Clinical presentation of chlorine gas intoxication
Chlorine gas is a strong irritant and may be corrosive to mucous membranes and eyes in concentrated amounts as occurs in industrial exposures. The severity of the

CASE 2
You are on duty in a provincial hospital when radio reports come in that a disaster has occurred in an outlying village of 10,000 people. Witnesses report that there was an explosion at a nearly chemical plant when a small single-engine airplane crashed into a storage tank. A greenish-yellow cloud of gas passed over a village where about 6,000 people were exposed.

Reports come in that hundreds of victims are unresponsive at the scene and others are being transported by buses and other vehicles to your emergency department (ED). Some are complaining of burning eyes, profuse lacrimation, blepharospasm, and eyelid edema. Some are reporting blindness. Hundreds are having trouble breathing and are coughing. Emergency personnel and lay volunteers are attempting to supply wet face cloths to individuals but are being attacked themselves by confused and distressed victims.

The first 75 victims arrive via buses and a few ambulances, with 4 or 5 individuals inside receiving oxygen by face mask. They are coughing, wheezing, and holding their eyes asking for help.

a. What is your role in this crisis?
b. Where do you report to?
c. What is the potential toxic gas that has been released in the incident?
d. What simple yet lifesaving techniques should you be prepared to deliver?
e. Was this an industrial accident or a terrorist event?
f. How do you prepare for the victims care?
g. What elements will you need for managing gas-intoxicated victims?
<table>
<thead>
<tr>
<th>Agent</th>
<th>Sight</th>
<th>Smell</th>
<th>Taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrolein</td>
<td>Colorless</td>
<td>Suffocating, pungent, acrid sweet</td>
<td>Metallic</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>Yellow-green gas</td>
<td>Unpleasant sweet peach</td>
<td>Tasteless</td>
</tr>
<tr>
<td>Allyl alcohol</td>
<td>Dry</td>
<td>Mustard</td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>Garlic</td>
<td>Dry urine</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>Odorless</td>
<td>Garlic</td>
<td></td>
</tr>
<tr>
<td>Arsine/stibine</td>
<td>Odorless</td>
<td>Garlic, fishy</td>
<td></td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>Odorless</td>
<td>Odorless</td>
<td></td>
</tr>
<tr>
<td>Cesium (radioactive)</td>
<td>Odorless</td>
<td>Bleach</td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>Odorless</td>
<td>Bitter almonds (50% of the population is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(persistent liquid)</td>
<td>unable to detect this smell secondary to</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>genetic polymorphism)</td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>Colorless</td>
<td>Sweet, musty, shellac-like or resembling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(persistent liquid)</td>
<td>peaches</td>
<td></td>
</tr>
<tr>
<td>Cyclosarin (GF)</td>
<td>Colorless</td>
<td>Sickly sweet smell</td>
<td></td>
</tr>
<tr>
<td>Diborane</td>
<td>Oily, colorless</td>
<td>Sweet, ether-like</td>
<td></td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>Colorless</td>
<td>Choking, acrid sweet</td>
<td></td>
</tr>
<tr>
<td>Fluorine</td>
<td>Colorless</td>
<td>Strong, suffocating, &quot;pickle-like&quot; odor</td>
<td></td>
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<tr>
<td>Formaldehyde</td>
<td>Colorless</td>
<td>Dry urine</td>
<td></td>
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<tr>
<td>Hydrazines</td>
<td>Colorless</td>
<td>Bleach</td>
<td></td>
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<tr>
<td>Hydrogen chloride</td>
<td>Oily, colorless</td>
<td>Decaying horse radish</td>
<td></td>
</tr>
<tr>
<td>Hydrogen fluoride</td>
<td>Colorless</td>
<td>Rotten eggs</td>
<td></td>
</tr>
<tr>
<td>Hydrogen selenide</td>
<td>Colorless</td>
<td>Geraniunns</td>
<td></td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>White, colorless</td>
<td>Odorless, but natural gas has mercaptan</td>
<td></td>
</tr>
<tr>
<td>Lewisite (vesicant)</td>
<td>Yellow to brown, oily</td>
<td>Odorless (slightly sweet at higher</td>
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<tr>
<td>Methane</td>
<td>liquid or colorless</td>
<td>concentrations)</td>
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<tr>
<td></td>
<td>(depending on agent)</td>
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<tr>
<td>Methyl bromide (neurotoxic</td>
<td>Colorless</td>
<td>Odorless (slightly sweet at higher</td>
<td></td>
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<tr>
<td>gas)</td>
<td></td>
<td>concentrations)</td>
<td></td>
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<tr>
<td>Methyl hydrazine</td>
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<tr>
<td>Methyl isocyanate</td>
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<tr>
<td>Methyl mercaptan</td>
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<tr>
<td>Mustards/Sulfur mustard</td>
<td></td>
<td></td>
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<tr>
<td>(blistering agents)</td>
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<tr>
<td>Nitric acid</td>
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<tr>
<td>Nitrogen dioxide</td>
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<tr>
<td>Organophosphates</td>
<td></td>
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<td></td>
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<tr>
<td>(depending on agent used)</td>
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<tr>
<td>Phosgene/Diphosgene</td>
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<td>Phosgene oxime</td>
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<tr>
<td>Phosphine</td>
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</tr>
<tr>
<td>Phosphorus, yellow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soman (GD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>White or colorless</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luminescent glow</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mustard</td>
</tr>
</tbody>
</table>
### TABLE 2 (continued)

<table>
<thead>
<tr>
<th>Agent</th>
<th>Sight</th>
<th>Smell</th>
<th>Taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur oxides/ Sulfur dioxide</td>
<td></td>
<td>Odor of “just-struck matches”</td>
<td></td>
</tr>
<tr>
<td>Tabun (GA)</td>
<td>Colorless</td>
<td>Faint fruity odor</td>
<td>Aromatic, sweet odor like benzene</td>
</tr>
<tr>
<td>Toluene</td>
<td>Pale, yellow liquid</td>
<td>Bleach, sharp pungent odor</td>
<td></td>
</tr>
<tr>
<td>Toluene diisocyanate</td>
<td></td>
<td></td>
<td>Odorless</td>
</tr>
<tr>
<td>VX (nerve agent)</td>
<td>Colorless</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Modified from “Chemical Terrorism: Diagnosis and Treatment” poster produced by the American College of Emergency Physicians

### TABLE 3. Common sources for chemical exposures

<table>
<thead>
<tr>
<th>Adhesives:</th>
<th>Glass etching:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile</td>
<td>Hydrogen fluoride</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anticorrosives:</th>
<th>Medical instrument sterilization:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrazines</td>
<td>Ethylene oxide</td>
</tr>
<tr>
<td>Methylhydrazines</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cleaners/Disinfectants:</th>
<th>Metal cleaners:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>Nitric acid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Detergents:</th>
<th>Metal etching:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>Nitric acid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dyes:</th>
<th>Pesticides (liquid that is directly sprayed on plants for pest and/or weed control):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile</td>
<td>Allyl alcohol</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Ammonia</td>
</tr>
<tr>
<td>Organophosphates</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fertilizer:</th>
<th>Photography:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>Cyanide</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foam insulants:</th>
<th>Pools/Hot tubs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>Chlorine</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food:</th>
<th>Rust removers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botulinum (especially honey and home-canned products)</td>
<td>Hydrogen fluoride</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fungicide:</th>
<th>Solvents:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>Hydrazine</td>
</tr>
<tr>
<td>Methylhydrazine</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fumigant (a gaseous pesticide that is released into a given area for pest and/or weed control):</th>
<th>Tissue Preservative:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile</td>
<td>Formaldehyde</td>
</tr>
<tr>
<td>Cyanide</td>
<td></td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td></td>
</tr>
<tr>
<td>Phosphine</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Germicide:</th>
<th>Wounds:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>Botulinum</td>
</tr>
</tbody>
</table>
exposure depends on different variables, including the concentration of the gas and the duration of the exposure. Despite the general belief, remember that the strength of the odor of the product is not a good indicator of the severity of the exposure. Table 5 shows the expected toxic effects according to the level of chlorine gas exposure.

In chlorine gas exposure the presence of pre-existing cardiopulmonary disease and the water content of the involved tissues are specific factors that determine the severity of the exposure. In serious
TABLE 5. Expected toxic effects according to the level of chlorine gas exposure

<table>
<thead>
<tr>
<th>Exposure levels in PPM</th>
<th>Toxic effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 ppm</td>
<td>Chlorine gas is detectable in the air as a pungent odor. Chronic exposure to these limits may induce anosmia (loss of the sense of smell).</td>
</tr>
<tr>
<td>1 ppm</td>
<td>Symptoms include respiratory tract irritation, dryness and scratchiness of the throat, coughing, and mild to moderate dyspnea.</td>
</tr>
<tr>
<td>15 ppm</td>
<td>Symptoms include severe dyspnea and violent headache.</td>
</tr>
<tr>
<td>30 ppm</td>
<td>Symptoms include intensive coughing, chest pain, nausea and vomiting, and shock.</td>
</tr>
<tr>
<td>1,000 ppm</td>
<td>Immediate death with a few breaths of this concentration.</td>
</tr>
</tbody>
</table>

Management for chlorine gas exposure

It is recommended that victims breathe fresh air or receive oxygen supplements by face mask, as well as have their eyes thoroughly rinsed in the decontamination and support zones at the incident site. In addition, give ED symptomatic victims oxygen supplementation and bronchodilators. Inhalation of sodium bicarbonate is suggested, although evidence-based proof of its efficacy is still lacking. Patients report relief with these therapeutic interventions.

Several uncontrolled case series report the efficacious use of nebulized sodium bicarbonate therapy in 3.75% to 5% concentrations. Some authors advocate its use on the basis of purported neutralization of hydrochloric acid formed when chlorine reacts with water in the airways. Give a single treatment of 3.75% sodium bicarbonate solution per hand-held nebulizer. Prepare the solution by diluting 2 mL of the standard pediatric IV sodium bicarbonate solution (8.4%) with 2.25 mL of normal saline. Low concentrations of sodium bicarbonate (3.75 to 4%) do not produce the exothermic reaction expected to occur when high concentrations are

Exposed, severe pulmonary irritation, pulmonary edema, and death may present quite rapid. Survivors of severe exposures may develop residual pulmonary dysfunction, such as reactive airway disease and low residual volumes. Corrosion is not likely with the concentrations liberated in accidental home production when mixing bleach with an acid-containing cleaner (e.g., usually <1 parts per million [ppm]). A level of 1 ppm, however, is often used as a 15-minute short-term exposure level (STEL) for chlorine for occupational health purposes. Minor exposures usually result in mild burning sensation in the chest, coughing, lacrimation, and tachycardia. Minor exposures in the home may require no treatment other than removal from the exposure with resolution of the symptoms occurring within 1 to 6 hours. Those patients with persistent symptoms or chronic lung problems may require further evaluation and treatment. In some patients, symptoms may be delayed for up to several hours after exposure to chlorine gas. See Appendix for more information regarding the timing of onset of signs and symptoms for different toxic exposures.

In some patients, symptoms may be delayed for up to several hours after exposure to chlorine gas.
used. In one controlled animal study, sodium bicarbonate improved gas exchange but there was no difference in lung histology or mortality at 24 hours.

**Biologic exposures**

Biologic agents used as warfare have significant potential to affect large portions of the population. Symptoms develop more insidiously with these agents than with chemical agents and, therefore, patients will present at different times and locations. Unlike chemical disasters, a hot zone can be extremely difficult, if not impossible, to establish.

With a child, the situation is further complicated by the fact that depending on the his/her age, accurate description of symptoms and onset may be difficult. Many therapies for biologic warfare agents have not been studied in children and therapeutic dosing may need to be adjusted to the child’s size. When a biologic agent is suspected, consult the Centers for Disease Control and Prevention (CDC) website at www.bt.cdc.gov for treatment and prophylactic guidelines pertaining to children. Also immediately notify state and local health officials so that an investigation into the possible outbreak can begin and appropriate infection control measures can be instituted. The CDC has categorized biologic agents into classes based on their ease of use, ability to cause harm, and ease of transmission (Box 5).

**Radiation exposures**

Humans are exposed to radiation on a daily basis. Radiation is produced by natural and man-made sources. Eighty percent of daily human exposure occurs from natural resources such as sunlight (gamma radiation), radon gas (produced by the decaying of uranium in soil), and cosmic rays.

Common man-made and generally well-tolerated exposures occur in the form of microwaves, radiographs in hospitals, and televisions. Most radioactive exposures cannot be perceived by the
human senses. Radioactive disasters can occur from leaks or damage to a nuclear power plant and nuclear or dirty bombs. A dirty bomb is a conventional explosive that is designed to release a radionuclide.

As previously mentioned in Section IV, slowly remove all the patient’s clothing and double bag it. Radioactive dust on clothing and skin can lead to further patient and healthcare personnel contamination. Carefully scrub all open wounds with soap and water in an effort to remove any radioactive dust that could lead to deeper contamination of the wound. All bodily fluids (urine, stool, vomit, etc.) are potentially contaminated in these patients and should be handled as toxic waste with proper disposal.

Specialty care is usually initiated at a hospital. Obtain a complete blood count (CBC) as soon as possible. Obtain CBCs three times a day for the following 2 to 3 days in order to follow the decline in lymphocytes. Collect nasal and skin swabs along with urine and stool samples to identify external and internal contamination. Notify the local health department immediately if rescue workers have not already done so.

Exposed patients must have an individual radiation dose assessment calculated. Medical personnel must often rely on clinical features for clues to exposure amounts. Consult experts with any suspected extensive radiation exposure to provide accurate dose assessment. Whole body irradiation is equal to 1 gray (Gy). A gray is an International System unit that is equal to 100 rads (radiation absorbed dose). Box 6 lists the clinical clues to determine the extent of a patient’s exposure.

Higher radiation exposures have more rapid symptom onset and increased severity of symptoms. Acute radiation syndrome develops in 4 phases: prodrome, latent, manifestation of illness, and recovery. Patients with very high levels of radiation exposure may experience all of these phases within hours prior to their deaths. The physician can use the length of the latent phase to roughly estimate possible exposure amount. Table 6 shows a brief description of each phase.

As mentioned previously, the outcome for radiation exposure is directly related to the exposure magnitude suffered by the patient. Children are more susceptible to radiation and therefore require lower radiation doses than adults to develop each potential outcome. Table 7 shows the potential outcomes and the recommended therapies for radiation doses in adults.

Potassium iodide therapy
Radioiodines are common isotopes released from nuclear power plant reactions. The thyroid is targeted by radioiodines and exposure puts one at risk
for future development of thyroid cancer. The younger victim naturally has a longer expected lifespan and consequently a longer time period in which the cancer can develop. Treat infants and children exposed to >0.05 Gy (5 rads) with potassium iodide (KI). KI will block thyroid uptake of radioiodines and help protect the thyroid from radioactive exposure. If given before the exposure, KI can prevent 100% of radioiodine uptake. If given after the exposure has occurred, the efficacy decreases quickly with time. If possible, give pediatric patients KI prior to or within 2 hours of exposure. If given 24 hours after exposure, the efficacy decreases to <10%. Table 8 shows KI dosing by age.

KI tablets can be dissolved in a pleasant tasting liquid, such as formula, milk, juice, or soda. Side effects are mild and include gastrointestinal distress and/or rash. One KI dose is effective for 24 hours. The half-life of KI is 5 hours to 7 days. Most patients require 1 dose. Once the exposure threat has passed, KI therapy will no longer be required. When removal from the exposure is impossible, subsequent doses will be required. Infants given 1 dose of KI should have their thyroid levels determined in 2 to 4 weeks. Those infants who were given multiple doses will require longer follow-up of their thyroid function.

Radioiodine is secreted into human milk. If possible, exposed lactating moth-

### Table 6. Phases of acute radiation syndrome

<table>
<thead>
<tr>
<th>Phase</th>
<th>Time period/Onset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prodrome</td>
<td>Hours to days</td>
<td>Nausea and vomiting</td>
</tr>
<tr>
<td>Latent</td>
<td>Days to weeks</td>
<td>Complete resolution of symptoms. The length of this phase is inversely proportional to exposure amount.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Several hours: 20 – 40 Gy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Few days to weeks: 6 – 8 Gy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. 2 to 6 weeks: 0.7 – 4 Gy</td>
</tr>
<tr>
<td>Illness manifestation</td>
<td>Usually 3rd to 5th week; with more severe exposures, will occur sooner.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intense immunsuppression, depending on exposure can have cerebrovascular, gastrointestinal (GI), hematopoietic, and cutaneous syndromes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Possible pneumonitis. In general, patients who survive this phase are likely to survive.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Hematopoietic syndrome (≥ 1 Gy): pancytopenia, immunodeficiency. Lymphocyte nadir seen in 8–30 days. 50% decline in lymphocytes within the 1st 24 hours, followed by a further decline 48 hours suggests a lethal exposure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Cutaneous syndrome: thermal or radiation burns, area of skin involvement may be small but penetration can be deep, resultant edema can lead to compartment syndromes.</td>
</tr>
<tr>
<td>Recovery</td>
<td>Weeks to months</td>
<td>Resolution of acute symptoms. Patients still have long-term effects such as increased risk for malignancy.</td>
</tr>
</tbody>
</table>

TABLE 6. Phases of acute radiation syndrome

KI will block thyroid uptake of radioiodines and help protect the thyroid from radioactive exposure. If given before the exposure, KI can prevent 100% of radioiodine uptake.
ers should not breastfeed their infants. If breastfeeding is continued, then those infants will require additional KI doses and longer thyroid function follow-up. Radioiodine is also secreted into the milk of livestock and accumulates in local produce. Physicians should instruct their families to refrain from giving their children animal’s milk or local produce until public health authorities have deemed it safe to consume these products.

### Thermomechanical disasters

Thermomechanical disasters involve situations where either a bomb has been deployed or an explosion has occurred. Most patients will present with physical injuries (head injuries, broken bones, crush injuries, and ear drum trauma), and burns. See Module 4, Pediatric Trauma, for injury and burn management. Medical personnel must be alert to signs of smoke inhalation with carbon monoxide and cyanide, because fire victims may have suffered toxin exposures. As with natural disasters, any force that disrupts the soil or structure of homes or nearby industries can lead to secondary chemical exposures. Be alert to clustering of symptoms that could suggest an ongoing toxin exposure in the area.

---

**TABLE 7. Radiation exposure outcome and therapy**

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Outcome</th>
<th>Therapies</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 20 Gy</td>
<td>Lethal</td>
<td>Comfort care</td>
</tr>
<tr>
<td>6–16 Gy</td>
<td>Likely lethal</td>
<td>Most resources suggest comfort care only.</td>
</tr>
<tr>
<td>5–10 Gy</td>
<td>Indeterminate</td>
<td>Repeated packed red blood cell and platelet transfusions (use leuko-reduced, irradiated cells to avoid development of graft vs. host disease), will likely need a bone marrow transplant for survival. Consider granulocyte-colony stimulating factor or figrastim therapies (very expensive and likely to only be available in small amounts).</td>
</tr>
<tr>
<td>2–5 Gy</td>
<td>Likely survival</td>
<td>Packed red blood cell and platelet transfusions as needed. Consider cytokine therapies.</td>
</tr>
<tr>
<td>&lt;2 Gy</td>
<td>Survival expected</td>
<td>Little to no medical management</td>
</tr>
</tbody>
</table>

**TABLE 8. KI dosing by age**

<table>
<thead>
<tr>
<th>Age</th>
<th>KI dosage (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to 1 month old</td>
<td>16</td>
</tr>
<tr>
<td>1 month - 3 years</td>
<td>32</td>
</tr>
<tr>
<td>4-17 years</td>
<td>65</td>
</tr>
<tr>
<td>&gt;17 years or &gt;70 kg*</td>
<td>130</td>
</tr>
</tbody>
</table>

---

[Note: *Radioiodine is also secreted into the milk of livestock and accumulates in local produce.*]

[Note: *As with natural disasters, any force that disrupts the soil or structure of homes or nearby industries can lead to secondary chemical exposures.*]
SUMMARY

Due to events in recent history, it is reasonable to plan for large-scale terrorist attacks that could involve weapons of mass destruction and chemical and/or biologic warfare. If this type of event were to occur, no amount of disaster planning could prevent the chaos that would erupt. Training should focus on attempts to organize the chaos while providing emergency personnel with knowledge on how to protect their own safety. However, natural disasters and accidental chemical leaks from nearby industries are the much more likely type of incident to occur involving large numbers of people with toxic exposures. Keeping that in mind, these guidelines should be followed by all emergency and rescue personnel:

- Know your area’s local industries and either be familiar with how to treat potential exposures or have guidelines available to provide proper therapies for each chemical.
- Know which natural disasters are more likely to occur in your area and acquire training for responding to these types of disaster scenarios.
- Know your area’s venomous animal population and have a knowledge in the available treatments/antidotes to these venoms.
- Be familiar with your community and health facility disaster plans. Know the equipment and medications available. Prioritize the protection of medical personnel.
- Treat the patient first, not the toxin.
SUGGESTED READING


Committee on Pediatric Emergency Medicine, Committee on Medical Liability and the Task Force on Terrorism. The pediatrician and disaster preparedness. Pediatrics, 2006; 117:560-565.


Han SZ and et al. Bioterrorism and catastrophe response: a quick-reference quide to resources. JADA. 2003; 134; 745-752.

http://www.bt.cdc.gov/
http://www.fema.gov/
http://www.osha.gov/
http://www.ncrp.com

RTI International. Cyanide: understanding the risk, enhancing preparedness. Clinical Toxicology, 2006; 44;47-63.

Case resolution

Case 1
You learn that these persons have been huddled in a partially damaged school. A group of about 30 to 40 individuals had gathered in a classroom and used two gas-powered generators to provide heat.

These patients’ symptoms are probably due to carbon monoxide intoxication, caused by gas combustion of the powered generators used in a closed shelter.

In the physical examination, look for neurologic, respiratory, and digestive signs associated with intoxication. Bright red skin is a typical sign.

When patients left the likely exposure site, they were able to breathe fresh air, which is the initial management for carbon monoxide intoxication. If signs of severe intoxication are found, then give 100% oxygen supplement via facial mask. Pulse oximetry is not useful for these patients. Obtain arterial blood gas to determine oxygen saturation.

Case 2
You suspect the gas released is chlorine, and you contact the poison control center (PCC), requesting management guidelines for chlorine gas exposure. Some of your colleagues do likewise. The electronic national surveillance system for the PCC contacts the medical director of the local PCC and questions why they have an inordinate number of irritant gas reports being entered into the electronic database.

Field data has been compiled and reported to the incident commander. The disaster is considered to be most likely accidental. Support personnel from EMS units in the country have arrived to assist in field triage and emergency care. Many victims are undergoing on-site decontamination, with special care taken in flushing eyes, as well as oxygen administration via face mask.

The PCC sends you a faxed document stating the variables that affect the severity of chlorine gas exposure and the appropriate management for this type of exposure.

About that time, multiple private vehicles pull up to the ambulance bay. Security and local police have set up controlled access to the ED. The mayor has requested assistance of the governor to supply National Guard troops to aid in the crowd control. Meanwhile, patients already in the ED are complaining that they have not been seen yet.

There should be a decontamination area in your ED with enough oxygen tanks and hand-held nebulizers to administer supplemental oxygen and bronchodilators to patients with severe clinical symptoms. Also, consider nebulized sodium bicarbonate.
MODULE REVIEW

SECTION I - VULNERABILITY OF CHILDREN

1. What are the most frequent disasters associated with potential exposure to hazardous substances?
2. What particular features make children more vulnerable than adults in toxicological disasters?
3. Describe the physiologic basis for such increased vulnerability.

SECTION II - RESPONSE IN TOXICOLOGICAL DISASTER SITUATIONS

1. What are the primary goals in preparedness for a disaster involving potential exposure to toxic substances?
2. What is the first priority in the response to a toxicological disaster?
3. What are the initial steps in the management for a disaster scene involving hazardous materials?
4. How would you define a hazardous material?
5. What factors should be considered in toxicological disaster planning and management?

SECTION III - PERSONAL PROTECTIVE EQUIPMENT

1. What types of personal protective equipment (PPE) are currently available?
2. What level of protection is associated with each PPE type?
3. Describe the appropriate steps when managing a disaster involving radioactive material.
4. What climate and geographical factors should be considered in the management of a toxicological disaster scene?
SECTION IV - GENERAL APPROACH TO THE TOXICOLOGICAL PATIENT

1. What are the first steps in the management of a toxicological disaster victim?
2. Describe the decontamination process.

SECTION V - NATURAL DISASTERS

1. What are the most frequent natural disasters associated with potential exposure to hazardous materials?
2. Describe the mechanisms involved in such association.
3. What are the main features in carbon monoxide and cyanide intoxications?
4. What is the immediate management for snake bites?

SECTION VI - MAN-MADE DISASTERS

1. Why is it critical for disaster management to know the industries in your influence area?
2. How can you initially identify a toxic substance involved in a disaster?
3. What clinical factors are significant in determining the risk for intoxication and the appropriate management?
4. What are the distinctive features that characterize the different types of biological agents potentially used as bioweapons?
5. What are the factors that affect the severity of an exposure to radioactive materials?
6. Describe the clinical features of the acute radiation syndrome.
7. What is the use of potassium iodide in the management for victims of radiation exposure?
CHEMICAL GLOSSARY

Acrolein
Sources: Manufacturing of biocides, pharmaceuticals, textiles, fuels, and synthetic rubber
Onset: Rapid
Symptoms:
  a. Respiratory: Chest pain, shortness of breath, pulmonary edema (immediate or delayed), pneumonia, acute lung injury leading to lung necrosis
  b. Dermatologic: Dermatitis; skin and mucous membrane irritation
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious amounts of water or saline.
Resources: EPA Substance Registry System (good resource with links to other sites):
http://iaspub.epa.gov/srs/srs_proc_qry.navigate?P_SUB_ID=24075 Office of Environmental Health Hazard Assessment:
http://www.oehha.ca.gov/air/chronic_rels/pdf/107028.pdf

Acrylonitrile
Sources: Plastics, adhesives, dyes, pharmaceuticals, fumigant
Onset: Rapid and delayed
Symptoms:
  a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonia, acute lung injury leading to lung necrosis
  b. Central nervous system (CNS): CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.
  c. Dermatologic: Dermatitis; skin and mucous membrane irritation
Treatment: Monitor respiratory status. Antiepileptics for seizure activity (benzodiazepines, barbiturates). Intubation and ventilatory support for decreased mental status and/or coma.
Metabolized to cyanide by the liver; consider cyanide antidote kit or hydroxocobalamin. Flush affected skin and mucous membranes with copious amounts of water or saline.
National Institute of Environmental Health Sciences (good resource):

Allyl alcohol
Sources: Pesticides, plastics, resins, perfume manufacturing
Onset: Rapid
Symptoms:
  a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonia, acute lung injury leading to lung necrosis
  b. Dermatologic: Dermatitis; skin and mucous membrane irritation
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious amounts of water or saline.
Resources: HazMap (NLM Specialized Information Services, which is an excellent resource for rapid data on toxicity for emergency purposes)

Ammonia
Sources: Explosives manufacturing; pesticides, detergents, fertilizer
Onset: Rapid
Symptoms:
  a. Respiratory: Chest pain, shortness of breath, cough, pulmonary edema, pneumonia, acute lung injury leading to lung necrosis
  b. Gastrointestinal: Esophageal contamination can lead to strictures
  c. Dermatologic: Irritation and even burns to skin and mucous membranes
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush all exposed skin and mucous membranes with water. If oral involvement, be sure to have patient “swish and spit” to avoid esophageal contamination. Full depth of chemical burn cannot be fully appreciated until after 24 hours. Treat all chemical burns as thermal burns.
Arseinic

**Sources:** Contaminated soil, water, and food. Released from different types of minerals and ores.

**Onset:** Rapid (10 minutes to several hours) and delayed (days to 3 weeks)

**Symptoms:**
- Respiratory: Chest pain, shortness of breath, cough, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
- Cardiac: Sinus tachycardia, arrhythmias, orthostatic hypotension, and cardiovascular shock.
- CNS: CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.
- Seizures occur secondary to microhemorrhages and cerebral edema. They typically occur days after exposure.
- Peripheral Nervous System: Peripheral neuropathy
- Hematologic: Leukopenia
- Renal: Acute renal failure, rhabdomyolysis
- Gastrointestinal: Nausea, vomiting, diarrhea, abdominal pain, hepatitis
- Dermatologic: Dermatitis; skin and mucous membrane irritation; patchy alopecia. About 5% will develop Mees lines in the nailbeds (represent disruption of nail matrix keratinization).

**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Antiepileptics for seizure activity (benzodiazepines, barbiturates). Dimercaprol or BAL chelation is indicated for acute arsenic poisoning.

**Resources:**
- http://www.cdc.gov/niosh/topics/arsenic/
- http://www.emedicine.com/emerg/topic42.htm

Arsine (also known as stibine)

**Sources:** Semiconductor and electronics industry

**Onset:** Delayed 2-24 hours

**Symptoms:**
- Hematologic: hemolysis

**Treatment:** Beware of hemolysis leading to renal failure. Consider urinary alkanization. Blood transfusions as needed or even exchange transfusion, which may be the treatment of choice for severe cases. Use of BAL chelation is controversial and no controlled trials have shown improved outcome or efficacy. The priority is removal of heme pigment and not necessarily the arsenic metal.

**Resources:** ATSDR and CDC are excellent resources with Medical Management Guidelines (MMG)

Botulimum

**Sources:** Produced from the bacteria *Clostridium botulinum*. The toxin can contaminate foods (especially honey and home-canned products) and wounds. This also can be used as a warfare agent when released as an aerosol.

**Onset:** Delayed hours to days

**Symptoms:**
- Peripheral Nervous System: double vision, difficulty speaking, dry mouth, drooping eyes, descending motor paralysis.

**Beware of respiratory paralysis!** In infants, presenting symptom can be constipation.

**Treatment:** Respiratory support as needed. Do not hesitate to intubate these patients. Trivalent (A, B, E) antitoxin is available from the Centers for Disease Control. When available, give the antitoxin as soon as botulism is suspected.

**Resources:**
- General Information/Treatment: Centers for Disease Control & Prevention: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/botulism_g.htm
- In general, for bioterrorism resource information go to this excellent site: http://www.bt.cdc.gov/
Carbon Monoxide
Sources: Engines, stoves, lanterns, burning charcoal and wood, gas ranges, and heating systems.
Onset: Rapid to delayed
Symptoms:
   a. Respiratory: chest pain, shortness of breath
   b. CNS: headache, dizziness, weakness, confusion.
   c. Gastrointestinal: nausea
   d. Dermatologic: "cherry red" appearance to skin
Treatment: Remove patient from source of exposure ensuring there is plenty of fresh air. Provide supplemental oxygen as needed.

Chlorine
Sources: Cleaners/disinfectants, water treatments (pools, hot tubs, etc.)
Onset: Rapid
Symptoms:
   a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
   b. Dermatologic: mucous membrane irritation
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious amounts of water or saline.
Resources: Agency for Toxic Substances and Disease Registry (ATSDR)

Cyanide
Sources: fumigant, electroplating, chemical synthesis, mineral extraction, photography, manufacturing of textiles, paper and plastics.
Onset: Rapid (either die quickly or rapidly recover)
Symptoms:
   a. CNS: CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.
   b. Metabolic: metabolic acidosis, cellular asphyxiant.
Treatment: Monitor respiratory status. Antiepileptics for seizure activity (benzodiazepines, barbiturates). Intubation and ventilatory support for decreased mental status and/or coma. Correct metabolic acidosis.
Antidote:
   1) Break amyl nitrite ampule and inhale for 30 seconds every minute. Repeat with a new ampule every 3 minutes until IV sodium nitrite can be administered. 2) 3% sodium nitrite – Adult: 10 cc IV, give in 5 minutes or less. Pediatric: 0.15–0.33 cc/kg (max. of 10 cc) IV, give in 5 minutes or less. 3) Sodium thiosulfate 25% solution – Adult: 12.5 g IV, pediatric: 412.5 mg/kg or 1.65 mL/kg of 25% solution IV. Cyanokit® (hydroxocobalamin) released by FDA for use in US has been used for years in UK for fire victims and other cyanide poisonings. Dose: 5 IV

Diborane
Sources: Chemical manufacturing, semiconductor production, rocket propellants
Onset: Rapid
Symptoms:
   a. Respiratory: respiratory irritant (cough, chest pain, chest tightness, shortness of breath)
   b. CNS: headache, drowsiness, shivering
   c. Gastrointestinal: nausea, vomiting
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema.

Ethylene oxide
Sources: Rocket propellants, ethylene glycol synthesis, fumigant, medical instrument sterilization
Onset: Rapid
Symptoms:
   a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
   b. CNS: CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.
   c. Dermatologic: Dermatitis; skin and mucous membrane irritation
**Fluorine**

**Sources:** Manufacturing of fluorides and fluorocarbons, rocket fuel component  
**Onset:** Rapid  
**Symptoms:**  
   a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis  
   b. Dermatologic: Corrosive; thermal burns/frostbite, chills  
**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious amounts of water or saline. Treat chemical burns as thermal injuries.

**Formaldehyde**

**Sources:** Germicide, fungicide, foam insulation, preservative; paper manufacturing  
**Onset:** Rapid  
**Symptoms:**  
   a. Respiratory: Chest pain, shortness of breath, pulmonary edema (immediate or delayed), pneumonitis, acute lung injury leading to lung necrosis  
   b. Dermatologic: Dermatitis; skin and mucous membrane irritation  
**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious amounts of water or saline.

**Hydrazines**

**Sources:** Rocket fuel, solvents, anticorrosives  
**Onset:** Rapid  
**Symptoms:**  
   a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis  
   b. CNS: CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.  
   c. Hematologic: Hemolysis, methemoglobinemia  
   d. Gastrointestinal: Nausea, vomiting, hepatotoxicity  
**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. For CNS symptoms: pyridoxime 25 mg/kg IV. Antiepileptics for seizure activity (benzodiazepines, barbiturates). For symptomatic methemoglobinemia: methylene blue 1-2 mg/kg IV to be given over 5 minutes.

**Hydrogen chloride**

**Sources:** Metal refining, manufacturing of vinyl chloride, rubber and chlorine  
**Onset:** Rapid  
**Symptoms:**  
   a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis  
   b. Dermatologic: Dermatitis (skin and mucous membrane irritation)  
**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious amounts of water or saline.

**Hydrogen fluoride**

**Sources:** Glass etching, rust removers, semiconductor production, volcanic emissions  
**Onset:** Rapid or delayed (depends on concentration)  
**Symptoms:**  
   a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis  
   b. Cardiac: Dysrhythmias  
   c. Metabolic: Hypocalcemia, hypomagnesemia, hyperkalemia, metabolic acidosis  
   d. Dermatologic: Corrosive, tissue penetration and destruction
APPENDIX

Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Place on a cardiac monitor. For hypocalcemia: calcium chloride (10% solution) 2–4 mg/kg IV, repeat as needed. For hypomagnesemia: Adult: magnesium sulfate 2–4 g IV to be given over 10 minutes. Pediatric: 25–50 mg/kg IV. For topical exposures: topical calcium gluconate gel vs. subcutaneous calcium gluconate. Inhalational exposure: 2.5% calcium gluconate nebulized solution. Flush affected skin and mucous membranes with copious amounts of water or saline. Treat chemical burns as thermal burns.

Hydrogen selenide
Sources: Glass, pigment and glaze manufacturing, plastic production, steel production and fabrication
Onset: Rapid and delayed
Symptoms:
- Respiratory: Bitter taste, chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
- Cardiac: Cardiovascular failure
- CNS: Headaches, chills
- Gastrointestinal: Nausea, vomiting

Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Place on a cardiac monitor.

Hydrogen sulfide
Sources: Chemical and heavy water manufacturing; agricultural disinfectant, metallurgy, volcanic emissions
Onset: Rapid
Symptoms:
- Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
- CNS: Headache, CNS depression
- Metabolic: Cellular asphyxiant, metabolic acidosis
- Dermatologic: Dermatitis; skin and mucous membrane irritation

Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Sodium nitrite may be of some benefit to critically ill patients (see cyanide for dosing). Flush affected skin and mucous membranes with copious amounts of water or saline.

Lewisite
Sources: Military agent
Onset: Rapid (IMPORTANT—sulfur mustard will have delayed pain vs. lewisite victims will have immediate pain to skin).
Symptoms:
- Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
- Cardiac: Cardiovascular failure
- Dermatologic: Blistering agent, immediate pain and irritation to skin and mucous membranes (including eyes). Blisters can lead to necrosis. Corneal ulceration and necrosis.

Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Give ophthalmic antibiotic ointment as needed. Flush affected skin and mucous membranes with copious amounts of water or saline. If available, apply 5% BAL ointment to affected skin within 15 minutes. Consider IM BAL or oral DMSA for severe exposures (cough with shortness of breath, frothy sputum, skin burn that was not decontaminated within 15 minutes, >5 % body surface area with evidence of immediate skin involvement). BAL: 3 mg/kg deep IM repeated every 4 hours x 2 days, then every 6 hours on the third day, then every 12 hours for up to 10 days. DMSA: 10 mg/kg orally every 8 hours x 5 days, then 10 mg/kg every 12 hours for the next 14 days.

Methyl hydrazine
Sources: Rocket fuel, solvents, anticorrosives
Onset: Rapid
Symptoms:
- Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
- CNS: CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.
- Hematologic: Hemolysis, methemoglobinemia
- Gastrointestinal: Nausea, vomiting, hepatotoxicity
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. For CNS symptoms: pyridoxime 25 mg/kg IV. Antiepileptics for seizure activity (benzodiazepines, barbiturates). For symptomatic methemoglobinemia: methylene blue 1-2 mg/kg IV to be given over 5 minutes.

Methyl isocyanate
Sources: Pesticide carbamate production
Onset: Rapid
Symptoms:
  a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
  b. Dermatologic: mucous membrane irritation
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious water or saline.

Methyl mercaptan
Sources: Gas odorant; production of pesticides, fungicides and jet fuel
Onset: Rapid
Symptoms:
  a. Respiratory: Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis
  b. Cardiac: Hypertension
  c. CNS: CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.
  d. Hematologic: Hemolysis and methemoglobinemia
  e. Gastrointestinal: Nausea, vomiting, diarrhea
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Antiepileptics for seizure activity (benzodiazepines, barbiturates). For symptomatic methemoglobinemia: methylene blue 1-2 mg/kg IV to be given over 5 minutes. Consider urinary alkanization. Blood transfusions as needed.

Mustards
Sources: Military agent
Onset: 1-2 hours (IMPORTANT—sulfur mustard will have delayed pain vs. lewisite victims will have immediate pain to skin).
Symptoms:
  b. Hematologic: Bone marrow suppression
  c. Gastrointestinal: Nausea and vomiting
  d. Dermatologic: Blistering agent, delayed pain and irritation to skin and mucous membranes (including eyes). Blisters can lead to necrosis. Corneal ulceration and necrosis.
Treatment: Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Ophthalmic antibiotic ointment as needed. Flush skin with copious amounts of water or saline even if the patient is asymptomatic. Unroof large bullae only. Do not apply topical antibiotic ointment unless there is a proven source of infection.

Nerve agents (fenthion, tabun, soman, sarin, VX)
Sources: Military agent
Onset: Rapid
Symptoms:
  a. CNS: CNS depression, possible coma, seizures, confusion, dizziness. Beware of respiratory depression.
  b. Peripheral Nervous System:
   • Muscarinic effects: Diarrhea, pinpoint pupils, bradycardia, bronchospasm, vomiting, increased pulmonary secretions, sweating, salivation, tearing eyes
   • Nicotinic effects: Dilated pupils, tachycardia, weakness, hypertension, hyperglycemia, tremors
Treatment: Atropine (treats muscarinic effects only); dose: 2–5 mg IV/IM slowly. Repeat every 5 to 10 minutes until drying of pulmonary secretions. Pralidoxime (treats muscarinic and nicotinic effects); dose: IV 1–2 gm to be given over 30 minutes every 6 to 12 hours. May repeat in 1 hour if nicotinic symptoms persist. Pralidoxime drip therapy: 1–2 g IV given over 30 minutes followed by 500 mg/hr drip. IM; 1–2 g every 6 to 12 hours. May repeat in 1 hour if nicotinic symptoms persists. Antiepileptics for seizure activity (benzodiazepines, barbiturates).
Nitric acid  
**Sources:** Fertilizer, gun powder and explosives manufacturing; metal etching and cleaning; organic synthesis  
**Onset:** Rapid  
**Symptoms:**  
- b. Dermatologic: Corrosive, tissue penetration and destruction, severe burns.  
**Treatment:** Immediate wet decontamination. Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious water or saline. Treat chemical burns as thermal burns.

Nitrogen dioxide  
**Sources:** Chemical synthesis; nitric acid production; explosives  
**Onset:** Delayed  
**Symptoms:**  
- a. Respiratory: High concentrations can cause upper airway irritation. Delayed respiratory effects. Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis.  
**Treatment:** Make patient rest. Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema.

Organophosphates  
**Sources:** Pesticides  
**Onset:** Rapid  
**Symptoms:**  
- a. Peripheral Nervous System:  
  - Muscarinic effects: Diarrhea, pinpoint pupils, bradycardia, bronchospasm, vomiting, increased pulmonary secretions, sweating, salivation, tearing eyes  
  - Nicotinic effects: Dilated pupils, tachycardia, weakness, hypertension, hyperglycemia, tremors  
**Treatment:** Atropine (treats muscarinic effects only); dose: 2–5 mg IV/IM slowly. Repeat every 5 to 10 minutes until drying of pulmonary secretions. Pralidoxime (treats muscarinic and nicotinic effects); dose: IV 1–2 g to be given over 30 minutes every 6 to 12 hours. May repeat in 1 hour if nicotinic symptoms persist. Pralidoxime drip therapy: 1–2 g IV given over 30 minutes followed by 500 mg/hr drip. IM: 1–2 g every 6 to 12 hours. May repeat in 1 hour if nicotinic symptoms persist.

Phosgene/Diphosgene  
**Sources:** Organic compound synthesis, burning of foam; military agent  
**Onset:** Delayed (24–48 hours)  
**Symptoms:**  
- a. Respiratory: High concentrations can cause upper airway irritation. Forms hydrochloric acid in the lungs. Delayed respiratory effects. Chest pain, shortness of breath, pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis. Can be fatal even with small exposures.  
**Treatment:** Make patient rest. Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema.

Phosgene oxime  
**Sources:** Military agent  
**Onset:** Rapid  
**Symptoms:**  
- b. Dermatologic: Corrosive, tissue penetration and destruction, immediate severe burns. Urticant.  
**Treatment:** Immediate decontamination. Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Flush affected skin and mucous membranes with copious water or saline. Symptomatic wound care. Treat chemical burns as thermal burns.

Phosphine  
**Sources:** Manufacturing of semiconductors; fumigant  
**Onset:** 1–2 hours and delayed  
**Symptoms:**
a. Respiratory: Chest pain, shortness of breath, delayed pulmonary edema, pneumonitis, acute lung injury leading to lung necrosis.
b. Cardiac: Cardiogenic shock, hypotension
c. CNS: CNS depression, possible coma, seizures, confusion, dizziness. **Beware of respiratory depression.**
d. Metabolic: Cellular asphyxiant; decreases ATP production, metabolic acidosis.

**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. Anticipate need for circulatory support. Antiepileptics for seizure activity (benzodiazepines, barbiturates).

**Ricin**

**Sources:** Military agent; derived from the processing of castor beans.

**Onset:** Delayed (hours)

**Symptoms:**


b. CNS: Headaches, weakness

c. Gastrointestinal: With ingestion, can see gastrointestinal bleeding, shock, hepatic, splenic and renal necrosis.

**Treatment:** For inhalational exposures give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema. For oral exposures do GI decontamination, give blood transfusions as needed and provide supportive care.

**Sulfur oxides/Sulfur dioxide**

**Sources:** Disinfectant, preservative, bleaching agent

**Onset:** Rapid

**Symptoms:**

a. Respiratory: Chest pain, shortness of breath, pulmonary edema, bronchoconstriction, pneumonitis, acute lung injury leading to lung necrosis

**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema.

**Toluene**

**Sources:** Gasoline, household products and cigarette smoke

**Onset:** Delayed (24 hours)

**Symptoms:**

a. Respiratory: Chest pain, shortness of breath, pulmonary edema, bronchoconstriction, pneumonitis, acute lung injury leading to lung necrosis

**Treatment:** Give supplemental oxygen, bronchodilators, intubation and ventilatory support as needed. Consider diuretics for pulmonary edema.

**Toluene diisocyanate**

**Sources:** Toner, clay, and glass products, manufacturing of miscellaneous plastic products, and petroleum refining

**Onset:** Delayed (24 hours)

**Symptoms:**

a. Cardiac: Dysrhythmias

**Treatment:** Place on a cardiac monitor.