

# C HAPTER 1

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## Disaster and Terrorism Preparedness: What Pediatricians Need To Know\*

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**R**ecent events of terrorism and war have heightened society's recognition of the need for emergency preparedness. Moreover, the possibility of additional terrorism on US soil has become increasingly likely, so much so that billions of dollars have been allocated to massive investments in homeland security and public health readiness. Yet the concept of preparing for disasters is not new. For decades, emergency planning for natural disasters, workplace accidents, and other calamities has been the responsibility of government agencies on all levels and certain nongovernment organizations such as the American Red Cross.

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\*Supported in part by grant No 1 R13 HS13855 from the Agency for Healthcare Research and Quality, grant No 1 H34 MC 00122-01 from the EMSC Program of the Maternal and Child Health Bureau, Health Resources Services Administration, Department of Health and Human Services, and by funding provided by The Children's Health Fund.

Because traditional disaster planning has encompassed, by and large, discrete incidents and geographically circumscribed areas, the preparedness and recovery process usually depends on local resources supplemented by state and federal support as needed. Furthermore, most emergency plans have to do with relatively familiar challenges (floods, hurricanes, industrial accidents, and the like) and straightforward consequences. Differences among various incidents are usually due to scale and local conditions.

In the case of terrorism, however, entirely new approaches to emergency planning are under development for a variety of reasons. First, timing of potential terrorist attacks is erratic and entirely unpredictable. Unlike hurricanes, there is no season for a biological attack launched by a politically hostile nation or group. Second, attacks can be of any size and occur in multiple areas simultaneously or sequentially, severely taxing resources at every level. Third, the possibility as well as the reality of terrorism engenders substantial psychological trauma, and virtually the entire population may experience deleterious consequences beyond the actual damage of the attack itself. Finally, the actual weapons of terror are not generally familiar to the public, to medical and public health officials, or even to traditional disaster planners.

The challenge of dealing with the threat of terrorism in the United States is daunting not only for disaster planners, but also for our medical system and health professionals of all types, including pediatricians. As part of the network of health responders, for instance, pediatricians need to be able to answer concerns of patients and families, to know when to recognize signs of possible exposure to a weapon of terror, to understand first-line response to such attacks, and to sufficiently participate in disaster planning to ensure that the unique needs of children are satisfactorily addressed in the overall process.

To fulfill these roles and responsibilities, the question becomes precisely what pediatricians must know with respect to coping with or preparing for terrorism and other future disasters. Clearly, a substantial body of mostly unfamiliar cognitive information is important. This may pertain to highly unusual or even formerly eradicated biological agents such as Ebola virus or smallpox, chemical weapons that attack the nervous system such as VX or sarin gas, or radiologic byproducts released in the event of a catastrophic event at a nuclear power plant or detonation of a "dirty bomb" (a conventional bomb to which a radioactive substance has been added).

For pediatricians and other primary clinicians in practice, considerable information is currently available on virtually all of these

issues in recently produced printed materials, at special conferences, in broadcasts of various types, and on the World Wide Web. However, selecting appropriate, accurate sources of information and determining how much information is sufficient remain difficult challenges. Similarly, guidance is needed with respect to developing relevant curricula for medical students and postdoctoral clinical trainees.

This chapter is designed to provide an overview of key issues for the pediatrician with respect to terrorism and disaster preparedness. It is not intended to be a complete compendium of didactic content, but it does represent an approach to understanding what needs to be learned by the pediatrician on this difficult topic and how pediatricians must lend their expertise and perspective to the urgent national need to enhance preparedness in every community.

To optimally prepare pediatricians as clinicians, educators, public health professionals, and advocates for children, curricula focused on terrorism and disaster preparedness should encompass a number of key concepts:

- Unique aspects of children related to terrorism and other disasters
- Terrorism preparedness
- Mental health vulnerabilities and development of resiliency
- Managing family concerns about terrorism and disaster preparedness
- Office-based preparedness
- Hospital preparedness
- Community, government, and public health preparedness
- Advocating for children and families in preparedness planning

## **UNIQUE ASPECTS OF CHILDREN RELATED TO TERRORISM AND DISASTERS**

The special needs of children have rarely been considered in disaster planning and have almost never been considered in terrorism preparedness. Planning must consider children who are at home, in school or day care, or in transit, as well as children who cannot be reunited with their families. Children with special health care needs are particularly vulnerable, especially if their survival depends on technologic means.

Children are uniquely vulnerable to disasters and terrorist events because of anatomic, physiologic, and clinical factors, as well as developmental and psychological concerns. While children may respond more rapidly to therapeutic intervention, they are at the same time more susceptible to various agents and conditions and more likely to deteriorate if not carefully monitored and treated.

The release of chemical or biological toxins would disproportionately affect children through several mechanisms. For example, because children become dehydrated easily and possess minimal reserve, they are at greater risk than adults when exposed to agents that may cause diarrhea or vomiting. Agents that might cause only mild symptoms in an adult could lead to hypovolemic shock in an infant.

Another example involves the unique respiratory physiology of children. Many of the agents used for both chemical and biological attacks are aerosolized (eg, sarin, chlorine, or anthrax). Because children have faster respiratory rates than adults, they are exposed to relatively greater dosages and will suffer the effects of these agents much more rapidly than adults. Children will also potentially absorb more of the substance before it is cleared or diffuses from the respiratory tissues. Many chemical agents, including certain gases such as sarin and chlorine, have a high vapor density and are heavier than air, which means they "settle" close to the ground, in the air space used by children for breathing.

Many biological and chemical agents are absorbed through the skin. Because children have more permeable skin and more surface area relative to body mass than adults, they receive proportionally higher doses of agents that either affect the skin or are absorbed through the skin. In addition, because the skin of children is poorly keratinized, vesicants and corrosives result in greater injury to children than to adults. A further concern in children because of their relatively large surface area in relation to body mass is that they lose heat quickly when showered. Consequently, skin decontamination with water may result in hypothermia unless heating lamps and other warming equipment are used.

In terms of radiologic exposures, children are also more vulnerable than adults. First, children have a disproportionately higher minute ventilation, leading to greater respiratory exposure to radioactive gases. Nuclear fallout quickly settles to the ground, resulting in a higher concentration of radioactive material in the space where children live and breathe. Children have a significantly greater risk of developing cancer even when they are exposed to radiation in utero.

Finally, children are particularly vulnerable because of physical developmental limitations. Infants, toddlers, and young children may not have the motor skills to escape from the site of a biological or chemical incident. Even if able to walk, they may not have the cognitive ability to understand the presence of a risk based on a terrorist event and therefore not seek an escape or be able to decide in

which direction to flee. Even worse, children may actually migrate toward a terrorist event out of curiosity to see the gas, colored agent, or other effects.

## **TERRORISM PREPAREDNESS**

Terrorism preparedness is a specific type of preparedness that is a component of general emergency preparedness. In addition to the unique pediatric issues involved in general emergency preparedness, terrorism preparedness must consider several additional issues, including the unique vulnerabilities of children to various agents, as well as the limited availability of age- and weight-appropriate antidotes and treatments.

Pediatricians must understand the following: (1) the classification and qualities of possible biological agents, (2) the natural history and management of biological, chemical, and radiologic injuries and exposures, (3) chemical agents that may be used and their properties, (4) different types of radiologic terrorism, (5) decontamination procedures, and (6) availability of antidotes and other therapeutics.

## **BIOLOGICAL AGENTS**

Biological weapons are referred to as the "poor man's nuclear bomb" because they are easy to manufacture, can be deployed without sophisticated delivery systems, and have the ability to kill or injure hundreds of thousands of people. Simple devices such as crop-dusting airplanes or small perfume atomizers are effective delivery systems for biological agents. In contrast to chemical, conventional, and nuclear weapons that generate immediate effects, biological agents are generally associated with a delay in the onset of illness, and therefore may not be recognized in their initial stages.

Biological weapon releases on civilian populations have also occurred in the recent past. In 1984 in Oregon, approximately 750 people experienced salmonellosis after bacteria were spread on salad bars in an effort to disrupt local elections. An inadvertent release of anthrax in April 1979 by a military facility in Sverdlovsk, in the former Union of Soviet Socialist Republics, produced mass infection as distant as 50 km, with 66 documented deaths.

As a weapon, biological agents possess a marked diversity in the type of injury produced by infectious agents, with toxic effects ranging from incapacitation to death. The biological agents listed in Table 1 are considered to be likely candidates for weaponization. These agents may be classified as bacteria, viruses, rickettsia, fungi, and preformed toxins.

**TABLE 1.**  
Biological Agents Likely to Be Used as Weapons

Bacteria	<i>Bacillus anthracis</i> (anthrax) <i>Brucella abortus</i> , <i>B melitensis</i> , <i>B suis</i> (brucellosis) <i>Burkholderia mallei</i> , <i>B pseudomallei</i> <i>Clostridium botulinum</i> (botulism) <i>Francisella tularensis</i> (tularemia) <i>Yersinia pestis</i> (plague)
Viruses	Crimean-Congo hemorrhagic fever Eastern equine encephalitis virus Ebola virus Equine morbillivirus Lassa fever virus Marburg virus Rift Valley fever virus South American hemorrhagic fever virus Tickborne encephalitis complex Variola (smallpox) Venezuelan equine encephalitis virus Hantavirus Yellow fever virus
Rickettsia	<i>Coxiella burnetii</i> (Q fever) <i>Rickettsia prowazekii</i> (epidemic typhus) <i>Rickettsia rickettsii</i> (Rocky Mountain spotted fever)
Fungi	<i>Coccidioides immitis</i> (coccidioidomycosis)
Toxins	Abrun Aflatoxin Botulinum toxins <i>Clostridium perfringens</i> epsilon toxin Conotoxin Diacetoxyscirpenol Ricin

Although virtually any microorganism has the potential to be used as a biological weapon, most would be difficult to weaponize and disseminate effectively. So while those listed in Table 1 are possible candidates for weaponization, the biological agents most likely to be used as possible terrorist agents are *Bacillus anthracis* (anthrax), *Brucella* species (brucellosis), *Clostridium botulinum* (botulism), *Francisella tularensis* (tularemia), *Yersinia pestis* (plague), Ebola virus, variola (smallpox), the hemorrhagic fever viruses, and *Coxiella burnetii* (Q fever).

The Centers for Disease Control and Prevention (CDC) separates bioterrorist agents into 3 categories<sup>1</sup> (A, B, and C) in order of priority based on the combined factors of availability, potential for morbidity and mortality, and ease of dissemination.

**Category A:** Agents in category A are believed to have the greatest potential for use as a biological weapon. Examples include the agents of smallpox, botulism, anthrax, tularemia, plague, and the viral hemorrhagic fevers. In general, they meet the following criteria:

- *Easily disseminated or transmitted.* Can either be aerosolized or spread through secondary contact.
- *High mortality.* Results in casualties well above what would occur from endemic levels of the disease with the likelihood of creating an outbreak.
- *Social disruption.* Results from the public's reaction to news of a bioterrorist attack and the possible lack of adequate resources by local response teams.
- *Special preparation.* Requires the health care community to take special measures to prepare for a bioterrorist attack; for example, stockpiling of antibiotics, isolation rooms, and extensive tracking and monitoring systems.

**Category B:** Agents in category B are moderately easy to disseminate and cause moderate morbidity and low mortality. Specific enhancements of the diagnostic abilities and disease surveillance systems of the CDC are required for detection. Agents or conditions in this class include *C burnetii* (Q fever); *Brucella abortus*, *B melitensis*, and *B suis* (brucellosis); the viral encephalitides; staphylococcal enterotoxin B; and food or waterborne agents (eg, *Salmonella*).

**Category C:** Agents in category C include emerging pathogens that because of availability, ease of production and dissemination, and potential for high morbidity and mortality could be engineered for future use. Agents or conditions in this class include Nipah virus, hantavirus, tickborne hemorrhagic fever, yellow fever, and multidrug-resistant tuberculosis.

### Specific Bacterial Agents

**ANTHRAX.**—Anthrax has been extensively developed as a biological weapon and is considered the most likely candidate for a biological release. Recent history in New York City, Connecticut, and Florida has shown that the use of anthrax as a terrorism agent is not a theoretic possibility but a reality. The causative organism, *B anthracis*, is a gram-positive sporulating rod. Because the initial symptoms of an-



thrax are nonspecific, and experience with the disease among physicians is uncommon, anthrax may be misdiagnosed.

Most experts believe that a bioterrorist attack with anthrax would most likely involve aerosol exposure. The incubation period for inhalation anthrax is usually less than 1 week, but there have been cases with incubation periods of 30 days. The first indication of an aerosol exposure may be groups of patients presenting with severe influenza-like disease with a high case-fatality rate. After a few hours or days, and possibly some improvement, the condition then progresses to fever, dyspnea, and eventually shock. A widened mediastinum consistent with lymphadenopathy or hemorrhagic mediastinitis is common. Usually, no evidence of bronchopneumonia exists. Anthrax cannot be transmitted person to person.

Although treatment is unlikely to be effective once the patient is ill, it can prevent patients from becoming sick if begun soon after exposure. Terrorists would likely use strains that were resistant to penicillin or doxycycline, so quinolones would be preferred until susceptibility is known. As a result, treatment for confirmed inhalation cases includes a combination of agents, particularly either ciprofloxacin or doxycycline, along with clindamycin and penicillin G. Patients who are stable after 14 days can be switched to a single oral agent to complete a 60-day course of therapy.

The preferred prophylactic regimen includes administration of both vaccine<sup>2</sup> (3 times at 0, 2, and 4 weeks) and antibiotics (ciprofloxacin or doxycycline) for 30 days. The anthrax vaccine is currently in limited supply, and if it is not available, antibiotics should be given for 60 days because spores can persist in tissues for a long time. The choice of ciprofloxacin as the initial agent for prophylaxis is based on the belief that weaponized anthrax is most likely going to be a resistant strain. Other quinolones (eg, levofloxacin, moxifloxacin, gatifloxacin) are assumed to also be effective. Despite ciprofloxacin being the only drug approved for prophylaxis against aerosol anthrax, its use in children has been questioned because of a theoretic risk of cartilage damage from animal studies. However, it is still recommended that ciprofloxacin be used in children as the initial prophylactic agent simply because the possibility of resistant strains is high. If, ultimately, the strain is found to be sensitive, amoxicillin can be used as an alternative for the remainder of the course of treatment. Based on current information, an amoxicillin dosage of at least 45 mg/kg/d, divided into 3 (ie, 15 mg/kg) and given every 8 hours, to children weighing less than 40 kg should result in adequate plasma concentrations for susceptible isolates of *B anthracis* for 75% to 100% of the dosing interval. Daily dosages of less than 45 mg/kg and

dosing intervals greater than every 8 hours should not be used for prophylaxis of postexposure inhalational anthrax.

**PLAGUE.**—Plague, caused by *Y pestis*, is also considered a potential bacterial weapon. Unlike anthrax, pneumonic plague can be highly contagious, and if untreated, the mortality rate can be as high as 100%. The pneumonic form of plague would be the primary form seen after purposeful aerosol dissemination of the organism. The bubonic form would be seen after purposeful dissemination through the release of infected fleas. All human populations are susceptible. Recovery from the disease may be followed by temporary immunity. The organism probably remains viable in water and moist meals and grains for several weeks.

### Viruses

Viruses of concern include variola (smallpox), Ebola and other hemorrhagic viruses, and the viral encephalitides. Because smallpox was eradicated globally in 1980, and children are no longer being immunized, more than 80% of the adult population and 100% of children are susceptible to variola virus. The currently licensed smallpox vaccine (Dryvax, Wyeth, Philadelphia, Pa) makes no mention in its package insert of an approved age range. In practice, until the early 1970s, this vaccine was administered to 1-year-old children. The CDC currently recommends against vaccination of children younger than 1 year. In reality, all contraindications to smallpox vaccination are relative. After bona fide exposure, vaccination of even the youngest infants should be done.

The viral hemorrhagic fevers are a diverse group of illnesses that are caused by RNA viruses of several different viral families: the Filoviridae, including the Ebola and Marburg viruses; the Arenaviridae, including Lassa fever and the Argentinean and Bolivian hemorrhagic fever viruses; the Bunyaviridae, including various hantaviruses, Crimean-Congo hemorrhagic fever virus, and Rift Valley fever virus (a phlebovirus); and the Flaviviridae, including yellow fever virus, dengue hemorrhagic fever virus, and others. Although evidence of weaponization does not exist for many of these viruses, they should be considered in terrorism preparedness because of their potential for weaponization or aerosol dissemination, and because of likelihood for confusion with similar agents that might be weaponized.

### Toxins

Toxins derived from biological agents generally have the characteristics of chemical agents, producing illness within hours of exposure. These agents are not infectious. Botulinum toxin is produced

by the bacterium *C botulinum*; it is one of the most potent toxins known, and is 100,000 times more toxic than sarin. When inhaled, these toxins produce a clinical picture very similar to that of food-borne intoxication, although the time to onset of paralytic signs may actually be longer and may vary by type and dose of toxin. Treatment is available in the form of a trivalent antitoxin (types A, B, and E), and there is a pentavalent immunoglobulin (types A-E) available in limited supply for treatment of infantile botulism. The enterotoxin of *Staphylococcus aureus* is also incapacitating although not highly lethal, except in elderly or chronically ill people. Exposure to this toxin can produce severe diarrhea that results in marked fluid losses and frank shock. Ricin and aflatoxin are plant-derived toxins. Inhalation of ricin produces weakness, fever, cough, and pulmonary edema within 24 hours, with death from hypoxemia occurring in 36 to 72 hours.<sup>3</sup> When ingested, ricin produces severe vomiting and diarrhea, resulting in cardiovascular collapse. Treatment is supportive; there is no antidote.

## CHEMICAL AGENTS

### Classification and Typical Agents

Classes of chemical agents that have been used or are considered likely candidates for use in a chemical release are shown in Table 2, with examples of each class and possible antidotes if available. All are relatively easy to synthesize, do not require sophisticated missiles, bombs, or other delivery devices for dispersion through populations and, unlike most biological agents, are capable of producing illness rapidly. Many of these agents could be stolen from industry or transport vehicles rather than manufactured by terrorists.

**NERVE AGENTS.**—Nerve agents are highly toxic; as little as 1 mg can be lethal to an adult.<sup>4-6</sup> Most nerve agents are highly volatile, designed to produce gas clouds that are inhaled by victims. Sarin, in addition to being volatile, has a vapor density 4.86 times that of water, which means it is concentrated closer to the ground, and therefore, in the area where children breathe. Sarin has been made infamous by 2 recent, large-scale acts of civilian terrorism in June 1994 and March 1995 when a terrorist group in Japan released it into the subway system.

Because nerve agents are well absorbed through intact skin, treatment begins with safe, topical decontamination. Protection of health care personnel is key. Standard precautionary equipment such as surgical masks and gloves does not provide protection from nerve agents; health care workers must wear full protective gear and a self-contained breathing apparatus. Solutions such as soap and water or

dilute bleach are recommended to remove these chemicals from skin. Additional management includes supportive care and, in severe cases, administration of atropine and pralidoxime, which may be in the form of autoinjectors commonly known as Mark 1 kits. These kits are approved for use only in adults, but could be used in older children. In this case, it is recommended that in children aged 3 years and older, Mark 1 kits are used based on the information presented in Table 3.

For children younger than 3 years, the atropine and pralidoxime could be drawn from the autoinjector and then dosed based on weight. A pediatric autoinjector is sold overseas, but is not yet available in the United States.

The one recent development has been the approval of the Atropen® (atropine auto-injector) for children. While this was a step forward in that a terrorism preparedness device was approved for children it is not equivalent to what is available for an adult. For an adult there is the Mark-I kit which is the Atropen and the Pralidoxime ComboPen® (2-PAM auto-injector) as a single unit. Until a pediatric version of the atropine and 2-PAM auto-injector becomes available, children should be treated with the Mark-I kit based on the recommendations in Table 3.

**TABLE 2.**  
Chemical Agents

Class	Examples	Antidotes
Nerve agents	Tabun, sarin, soman, VX	Atropine, pralidoxime, diazepam
Vesicants	Mustard gas, nitrogen mustard	
Irritants/corrosives	Chlorine, bromine, ammonia	Nebulized albuterol
Choking agents	Phosgene	
Cyanogens	Hydrogen cyanide	Amyl nitrate, sodium nitrate, sodium thiosulfate
Incapacitating Agents		
CNS depressants	Cannabinoids, barbiturates	
Anticholinergics	3-Quinuclidinyl benzilate (BZ)	Physostigmine
Lacrimators	Capsaicin	

Abbreviation: CNS, Central nervous system.

(Adapted from American Academy of Pediatrics. Committee on Environmental Health and Committee on Infectious Diseases: Chemical-biological terrorism and its impact on children: A subject review. *Pediatrics* 105:662-670, 2000.)

**TABLE 3.**  
Autoinjector Usage

Approximate Age (y)	Approximate Weight (kg)	No of Autoinjectors (Each Type)	Atropine Dosage Range (mg/kg)	Pralidoxime Dosage Range (mg/kg)
3-7	13-25	1	0.08-0.13	24-46
8-14	26-50	2	0.08-0.13	24-46
>14	>51	3	0.11 or less	35 or less

Note: Each Mark 1 kit contains 2 autoinjectors (0.8-inch needle insertion depth), one each of atropine 2 mg (0.7 mL) and pralidoxime 600 mg (2 mL); while not approved for pediatric use, they should be used as initial treatment in circumstances for children with severe, life-threatening nerve agent toxicity for whom intravenous treatment is not possible or available or for whom more precise intramuscular (mg/kg) dosing would be logistically impossible. Suggested dosing guidelines are offered; note potential excess of initial atropine and pralidoxime dosage for age/weight, although within general guidelines for recommended total over first 60 to 90 minutes of therapy for severe exposures. Although this table describes usage of the Mark-1 kit for children 3 years and older based on adherence to recommended dosages for Atropine and Pralidoxim, following an actual nerve agent exposure if a Mark-1 Kit is the only available source of Atropine and Pralidoxime it should not be withheld from even the youngest child based on weight based dosing guidelines.

**VESICANTS AND IRRITANTS/CORROSIVES.**—Mustard gas, ammonia, and chlorine are corrosive chemicals that may be used in a terrorist incident. They affect the skin, eyes, and nasal mucosa, producing severe pain and incapacitation. If these chemicals are inhaled, life-threatening pneumonitis may also occur. The mainstay of therapy is skin decontamination by thorough showering. Pulmonary support including intubation and mechanical ventilation may be necessary for those with severe pulmonary injury.

**OTHER CHEMICAL AGENTS.**—Other agents listed are designed to incapacitate rather than kill. However, in persons with significant chronic illness, they can result in life-threatening toxicity.

#### Antidotes

The availability of adequate antidotes and treatments for children is also problematic. Most treatments and antidotes were developed for military personnel (ie, adults) who might be victims. Most of these agents have never been tested on children, and some are actually contraindicated in children. Furthermore, pediatric dosages and medications in preparations that can be administered to children are lacking or absent in general. Although there is ongoing development of new and improved antidotes and treatments to better protect our military and adult population, there is no parallel process in place for developing appropriate agents for use in children.

#### RADIOLOGIC AGENTS

Radiologic threats can be unintentional or intentional. Unintentional threats include power plant disasters such as Chernobyl and Three Mile Island. Intentional acts could be the result of military conflict or terrorism. There are 3 major types of radiation disaster threats:

- Detonation of a nuclear weapon, which although possible, is considered an unlikely terrorist action because of the sophistication and supply requirements to build such devices.
- Damage of a facility that contains nuclear material (eg, a nuclear waste reprocessing facility, a medical facility with storage of nuclear material, a food irradiation plant, or a nuclear power plant).
- Dispersal of nuclear material, either by detonation of a conventional explosive (a radioactive dispersal device or "dirty bomb") or the release of nuclear materials in transit via a dispersion device. Radioactive dispersal devices are designed to use radioactive material obtained from relatively accessible sources, such as university research laboratories or hospital radiation therapy centers. This last scenario is considered to be the most likely.<sup>7</sup>

#### Managing Radiation Exposure

The management of the child who has sustained significant radiation exposure depends on the type and degree of exposure as well as the presence of concomitant injuries. Principles of disaster management, including containment, decontamination, prehospital care, and field triage, are fully applicable.<sup>7</sup> The first phase of managing pediatric radiation victims is to determine whether topical decontamination is warranted. Simple removal of clothing is responsible for more than 90% of effective decontamination after a chemical or radiation exposure.<sup>8</sup> Initial medical management includes a careful assessment of airway, breathing, and circulation, particularly when there is the potential for blast or thermal injury. It is important to remember that most injuries caused by radiologic terrorism will be associated with a blast. While decontamination is key, most initial therapy will be that of standard trauma management. Surgical intervention, if warranted, should be performed as soon as possible, ideally within 48 hours of irradiation, before wound healing and immunity become impaired.

There are a variety of possible Radionuclides which can be produced after a radiologic disaster or terrorism. Each of them has their own toxicity and may have specific treatment. The radionuclides and their absorption, toxicity and treatment are listed in Table 4. It is



important that pediatricians and policy makers ensure availability of all of the medications listed in Table 4 for treatment of radiological internal contamination and that all testing of these agents and treatment protocols for these agents include considerations for the treatment of children.

**Potassium Iodide**

The only indication for the use of potassium iodide (KI) is the prevention of thyroid cancer. Pediatricians should take care to dispel any misconception that this product might be a generic “antiradiation pill.” KI is recommended only for children, pregnant women, or lactating mothers who have been or are likely to be exposed to radioactive iodine (<sup>131</sup>I). That is, not all radiologic events necessitate KI administration. Radioactive dispersal devices generally do not contain radioiodines, so administering KI after detonation of a radioactive dispersal device would be inappropriate. Release of <sup>131</sup>I is much more likely to be an issue after a nuclear power plant catastrophe.

KI saturates the thyroid, which then blocks the uptake of inhaled or ingested radioiodines. When it is taken during or shortly after radioiodine exposure and at the proper dosage, KI prevents radiation-induced effects on the thyroid.<sup>9</sup> According to current expert opinion, all exposed children should receive KI within 2 hours of exposure. In certain situations, such as a successful attack or a significant accident at a nuclear power facility, the first dose of KI can be administered before actual exposure.

Current recommendations are that KI be administered only after certain levels of radioiodine exposure have occurred or seem imminent. For children and pregnant or lactating women, this is if thyroid exposure is predicted to be 0.05 Gy (5 rad) or more. This approach is based on risk-benefit analyses derived from the Chernobyl disaster, in which more than 18 million children and adults in Poland (immediately adjacent to Ukraine and Belarus) received at least one dose of KI. One key consideration is that administration of KI to newborns has been associated with evidence of transient decreases in thyroxine along with increases in thyroid-stimulating hormone. As such, newborns should still receive KI if needed, but it is recommended that thyroid function is monitored in newborns who receive KI. Based on limited data, it is thought that monitoring thyroid function by measuring thyroid-stimulating hormone activity 2 to 4 weeks later should be sufficient after a single KI dose, but that further monitoring would be needed for newborns who receive more than one dose of KI.

**TABLE 4.** Radionuclides Produced After Radiologic Terrorism or Disaster, Internal Contamination, Toxicity and Treatment

Element	Respiratory Absorption	GI Absorption	Skin Wound Absorption	Primary Toxicity	Treatment
Americium	75%	Minimal	Rapid	Skeletal deposition Marrow suppression, hepatic deposition	Chelation with DTPA or EDTA
Cesium	Complete	Complete	Complete	Whole body irradiation	Prussian blue
Cobalt	High	<5%	Unknown	Whole body irradiation	Supportive
Iodine	High	High	High	Thyroid ablation, carcinoma	Iodine therapy
Phosphorus	High	High	High	Bone, rapidly replicating cells	Aluminum hydroxide
Plutonium	High	Minimal	Limited, may form nodules	Lung, bone, liver	Chelation with DTPA or EDTA
Radium	Unknown	30%	Unknown	Bone, marrow suppression, sarcoma	Magnesium sulfate lavage
Strontium	Limited	Moderate	Unknown	Bone	Supportive
Tritium	Minimal	Minimal	Complete	Panmyelocytopenia	Dilution with controlled water intake, diuresis
Tritiated water	Complete	Complete	Complete	Panmyelocytopenia	Dilution with controlled water intake, diuresis
Uranium	High	High to moderate	High absorption, skin irritant	Pulmonary, nephrotoxic	Chelation with DTPA or EDTA, NaHCO3 to alkalinize urine

This table was created from recommendations developed at the Consensus Conference and in part is based on reviewed reference materials from the American Academy of Pediatrics, Centers for Disease Control, FDA and Medical Management of Radiological Casualties, Armed Forces Radiobiology Research Institute, 1999



KI is also recommended for pregnant women to protect both themselves and the fetus.<sup>9</sup> Because of the potential risks, KI is given only once to pregnant women and newborns unless other protective measures (evacuation, sheltering, and control of the food supply) are unavailable.

On the basis of the protective effects of a dose of KI lasting approximately 24 hours, more than one dose may be needed if there is continued exposure to radiation. The need for more than one dose depends on evacuation, the continued exposure to radioiodine, the half-life of the agent used (can range from 5 hours to 7 days), and several other factors.

KI is currently available in 130-mg and 65-mg tablets. The tablet can be crushed and mixed in almost any liquid and then administered in a dose appropriate for the child's weight and age. Most experts agree that KI mixed with any of the recommended beverages will keep for up to 7 days in the refrigerator. Potassium iodide (SSKI) drops are available and can be administered if necessary. Unfortunately, at their extreme concentration of 1000 mg/mL, accurate dose titration for children is virtually impossible.

The Food and Drug Administration has also recently released guidelines for home preparation of KI for infants and children.<sup>10,11</sup> Because of its poor taste when put in solution, KI should be diluted in a solution with an attractive taste for children. If possible, the

**TABLE 5.**  
Marrow Stimulative Agents

Agent	Action	Dosage
Epoetin Alpha* (Epoen, Procrit)	Induces erythropoieses	150 units/kg/dose
Filgrastim (Neupogen)	Granulocyte Colony Stimulating Factor (GCSF)	5-10 mcg/kg/day (dosages of 20 mcg/kg/day may be needed in selected patients)
Sargramostim (Leukine)	Colony Stimulating Factor (AMCSF)	3-15 mcg/kg/day (dosages of 30 mcg/kg/day may be needed in selected patients)

\*Epoetin Alpha may also be useful to reduce the overall requirements for blood transfusion in any mass casualty incident.

Note: Dosage derived from Medical Management of Radiological Casualties, Armed Forces Radiobiology Research Institute, 1999 and accepted dosages for pediatric oncology and pediatric congenital neutropenia and erythropenia patients.

dose of KI should be based on age (Tables 6-8). However, if graded dosing is logistically impractical, because the risk of a higher dosage is far outweighed by the benefits of KI administration, KI may be given to children at a single dosage. Because this dosage may be higher than normally indicated, thyroid function should be monitored.

While potassium iodide is helpful for prevention of thyroid cancer following radioiodine exposure, there are other pharmaceutical agents to be considered. One category of pharmaceuticals which will be needed following a radiologic event are marrow stimulative agents. The marrow stimulative agents available and their dosages are those listed in Table 5. These medications should be available in pharmacological stockpiles and hospitals for radiological emergencies or terrorism. In addition to these medications anti-emetics should also be available to treat the emesis caused by this exposure and prevent dehydration for which children have increased susceptibility.

## DECONTAMINATION

Children exposed to biological or chemical agents are likely to require topical decontamination by showering. Whether or not to use decontamination procedures for asymptomatic persons after a known or suspected exposure is a decision that must be made before the agent has been identified. Many shower systems are not suitable for children, who require systems that use warm water and are high volume but low pressure. Shower decontamination units designed for young children and infants must also be able to accommodate an adult (parent or caretaker) as well as the child.

**TABLE 6.**  
Guidelines for Potassium Iodide (KI) Administration

Patient/Age	Exposure, Gy (rad)	KI Dose (mg)
>40 years of age	>5 (500)	130
18-40 years of age	0.1 (10)	130
12 through 17 years of age	0.05 (5)	65
4 through 11 years of age	0.05 (5)	65
1 month through 3 years of age	0.05 (5)	32
Birth through 1 month of age	0.05 (5)	16
Pregnant or lactating women	0.05 (5)	130

Children/adolescents weighing more than 70 kg should receive one 130-mg tablet. (Courtesy of US Food and Drug Administration, Center for Drug Evaluation and Research: *Guidance Document: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies*. Rockville, Md, Center for Drug Evaluation and Research, 2001.)

**TABLE 7.**

Guidelines for Home Preparation of Potassium Iodide (KI) Solution Using 130-mg Tablet

1. Put one 130-mg KI tablet in a small bowl and grind into a fine powder with the back of a spoon. The powder should not have any large pieces.
2. Add 4 tsp (20 mL) of water to the KI powder. Use a spoon to mix them together until the KI powder is dissolved in the water.
3. Add 4 tsp (20 mL) of milk, juice, soda, or syrup (eg, raspberry) to the KI/water mixture.  
The resulting mixture is 16.25 mg of KI per teaspoon (5 mL).
4. Age-based dosing guidelines:  
Newborn through 1 month of age = 1 tsp  
1 month through 3 years of age = 2 tsp  
4 years through 17 years of age = 4 tsp  
Children/adolescents weighing more than 79 kg should receive one 130-mg tablet.

(Courtesy of US Food and Drug Administration, Center for Drug Evaluation and Research: *Home Preparation Procedure for Emergency Administration of Potassium Iodide Tablets to Infants and Children Using 130 Milligram [mg] Tablets*. Rockville, Md, Center for Drug Evaluation and Research, 2002.)

### THE STRATEGIC NATIONAL STOCKPILE

Antidotes, antibiotics, vaccines, and other pharmaceuticals are key to treatment and prophylaxis after biological or chemical events. The CDC maintains many of these items as part of the Strategic National Stockpile, which is a program that provides for stored materials that can be deployed when needed. Although the CDC has designated both local sites and sites at the CDC (which may be distant

**TABLE 8.**

Guidelines for Home Preparation of Potassium Iodide (KI) Solution Using 65-mg Tablet

1. Put one 65-mg KI tablet in a small bowl and grind into a fine powder with the back of a spoon. The powder should not have any large pieces.
2. Add 4 tsp (20 mL) of water to the KI powder. Use a spoon to mix them together until the KI powder is dissolved in the water.
3. Add 4 tsp (20 mL) of milk, juice, soda, or syrup (eg, raspberry) to the KI/water mixture.  
The resulting mixture is 8.125 mg of KI per teaspoon (5 mL).
4. Age-based dosing guidelines:  
Newborn through 1 month of age = 2 tsp  
1 month through 3 years of age = 4 tsp  
4 years through 17 years of age = 8 tsp or one 65-mg tablet  
Children/adolescents weighing more than 70 kg should receive two 65-mg tablets.

(Courtesy of US Food and Drug Administration, Center for Drug Evaluation and Research: *Home Preparation Procedure for Emergency Administration of Potassium Iodide Tablets to Infants and Children Using 65 Milligram [mg] Tablets*. Rockville, Md, Center for Drug Evaluation and Research, 2002.)

from the event) for storing these agents, in many areas the time needed to distribute the agents to the patients remains a question. Moreover, appropriate dosages of many vaccines and antidotes have not been established for children, and the efficacy of many vaccines (such as anthrax) in children has not been studied. As such, many of the agents in the stockpile are not approved or are inappropriate for children. Also, many of these agents are not in preparations that can be appropriately dosed and administered to children (ie, liquid and dilute preparations). In addition, the equipment (eg, intravenous lines, solutions, etc) needed to administer these agents to children may not be available. Finally, certain antibiotic therapies supplied in the National Pharmaceutical Stockpile (eg, tetracycline) generally are not recommended for use in children.

### MENTAL HEALTH VULNERABILITIES AND DEVELOPMENT OF RESILIENCY

Disasters and especially terrorist attacks are frightening for adults and can be equally traumatic for children. Feelings of anxiety, confusion, and fear are all normal reactions. However, if children are anxious, frightened, or confused for long periods, it can have devastating long-term emotional effects on their well-being. All children are at risk of psychological injury such as posttraumatic stress disorder from experiencing or living under the threat of chemical or biological terrorism. In addition, their emotional responses are heightened by seeing their parents panicked or confused. Because children often cannot understand what is happening or the steps being taken to mitigate the event, they will often be fearful of the event and also of the potential for future events. In a mass casualty incident, children witness injuries and deaths, possibly of their parents, which would produce both short- and long-term psychological trauma.

### DEVELOPMENTAL PERSPECTIVES

How children understand and react to traumatic events such as sudden death, violence, or terrorism is related to their developmental abilities, which vary depending on age. A 6-year-old child, for example, may react by refusing to attend school. An adolescent, on the other hand, may minimize his or her concerns, but start to argue more with parents, become more irritable, or show a decline in school performance. The developmental abilities and normal reactions to stress of each age group are briefly described below.

*Infants and toddlers* react to trauma through nonspecific responses to the distress of their caregivers, and to separation and dis-

ruption in relationships and routines. Therefore, responses of infants and toddlers are largely determined by the caregiver's coping skills. Children in this age group may demonstrate fears of separation, become fussy, develop feeding and sleeping problems, and become easily startled.

*Preschoolers* often engage in magical thinking, develop fears of separation and rejection, and exhibit regressive behaviors. Normal reactions of preschoolers to stress may include uncontrollable crying, running aimlessly, excessive clinging and fear of being alone, regressive behavior, bed-wetting, sensitivity to loud noises, confusion and irritability, and eating problems. Another key feature in children of this age group is an inability to understand death as permanent. Preschoolers often display their emotional responses to trauma in the form of sleep difficulties (afraid to go to sleep, trouble falling asleep or staying asleep, nightmares). Feelings of worry and anxiety are sometimes exhibited as "clinging behavior," and children may refuse to leave their caretaker's side, worrying that something bad might happen to their caretaker. Children may be afraid to leave the house. Temper tantrums may also increase.

*School-age children* are capable of understanding simple, concrete explanations but have not yet acquired abstract reasoning abilities. They may display inappropriate or unpredictable behavior, deny affect (feelings), and focus on details. They may also complain of physical symptoms, show regressive behaviors, or withdraw. Children of this age group often become fearful, confused, and anxious after a trauma. They may also show symptoms of depression.

Normal reactions of school-age children to stress may include nonspecific physical symptoms such as loss of appetite and multiple physical complaints (stomachaches, headaches, dizziness). School-related issues are also common, such as loss of interest and inability to concentrate, refusal to attend school, or increased defiance, aggression, and hyperactivity. Other reactions include sleep changes (trouble falling asleep, bad dreams, or nightmares), sadness, withdrawal from peers, irritability, increased fearfulness (fear of the dark, fear of loud noises, etc), whining or clinging (reluctance to leave parent or teacher), competition with siblings for attention or regressive behaviors (eg, bed-wetting, thumb-sucking, baby talk carrying an object like a teddy bear or blanket). Prolonged fear of being alone, feelings of responsibility and guilt, safety concerns, and preoccupation with danger are also common. Finally, school-age children may experience loss of interest in activities and participate in repetitious play and retelling of the trauma.

*Adolescents* have developed the ability to think more abstractly and have a better sense of cause and effect. Teens want to make their own decisions and be more independent. Frequently, they need time alone and may occasionally isolate themselves from their family. Because of their ability for abstract thinking, teenagers tend to increase their focus on religion, spirituality, morality, and ethics, and this can have an impact on their understanding of, and response to, a traumatic event. More than at any other stage of development, children in the preteen and teenage years are likely to keep their feelings about the trauma inside, making them more prone to developing feelings of sadness and apathy. Increased defiance may appear, as may a wish for revenge and action-oriented responses to trauma. Other normal responses of adolescents to stress may include nonspecific physical problems (aches and pains), appetite changes, sleep changes (nightmares, trouble falling asleep), sadness, withdrawal and isolation, irritability and acting out, and excessive fears and worrying.

#### **APPROACHING PSYCHOLOGICAL CHALLENGES OF TERRORISM**

Adults can actively seek help, but children cannot; they depend on the adults in their lives to get them the assistance they need. Children are generally aware of their parents' worries and are particularly sensitive during a crisis. It is often appropriate and reasonable for parents to share their own concerns with their children, but at the same time stress their ability to cope with the situation and, importantly, to protect their children.

Parents can help children and adolescents process whatever news they receive of a disaster. Sometimes, young people believe that "nothing like that" would ever happen to them. Such ideas should be explored in a supportive way that also gently reminds a young person that certain kinds of disasters can touch any of us. Conversely, a young person may feel extremely vulnerable on hearing about a disaster that has occurred far away. These children should be encouraged to express their fears, and then gently but firmly reminded that most people survive disasters, and that they themselves are safe.

#### **ANSWERING QUESTIONS AND TALKING TO CHILDREN**

Many adults and children have questions after disaster and terrorist events. Children may ask why these events occur, if similar tragedies will happen again, and whether their families are safe. Adults want to know how to best explain to children what took place, how to handle their scared child, and how to develop a sense of security



within the family. Questions and concerns often continue long after an event has occurred. How do we better prepare ourselves for future events and know how to respond when they occur? How do we answer the tough questions that both adults and children ask when trying to deal with tragedy? How can we best help children cope with stressful times? When do we advise parents to seek mental health care for their child?

To be prepared for these and a multitude of other questions, pediatricians need to understand the mental health effects of disasters and terrorism on children, and children's reactions based on their developmental level. They should be able to advise parents and recognize the warning signs that require referral for more formal mental health assessment and therapy.

Pediatricians should ask parents about their children's awareness of previous or potential future terrorist attacks, their degree of exposure (including television) to these issues, and their previous and current reactions. Such queries may provide an opportunity to advise parents about how best to discuss terrorist attacks with their children. Depending on the ages, developmental abilities, and emotional states of their children, parents may want to eliminate or severely limit exposure to frightening images or reports in the media particularly broadcast television.

Pediatricians should encourage parents to be available for their children and to let their children ask questions. Parents are advised to present information to children honestly, simply, and to the best of their ability, using language appropriate to the child's developmental level and cognitive abilities. It may be tempting to say that everything is going to be fine, but children may find this somewhat dismissive because it does not help address their specific concerns. If parents are faced with a question that they just cannot answer they can acknowledge that they do not know, but reassure their children that they are doing everything possible to keep the family safe. Parents can tell children that it is the job of grownups to protect everyone, and that a lot of other people are thinking about safety and working really hard to protect the children from harm.

Parents can be encouraged to talk with their children about a specific plan that includes things to do in case of a terrorist incident whom to go to for help, safe places to seek, and other concrete steps that can be taken at home, at school, and in the community. The approach may be similar to that taken to prepare children for other potential threats, such as fire or approach by a stranger. The goal of these discussions should be to help the child feel potentially in con-

trol of a threatening situation and also to convey that the parents are in control, with specific plans to ensure safety.

Playing with children who are too young to ask questions is important because it allows children to express their feelings and to develop a sense of mastery and minimize their anxiety about the traumatic event. This is similar to adults retelling their experiences. Drawing pictures; playing with puppets, dolls, or other action figures; or engaging the child in any other structured activity works well.

### DEVELOPING RESILIENCY

With the appropriate support and guidance, children can develop the skills and resiliency needed to deal with, overcome, and possibly even grow from traumatic experiences. Clearly, children have the inherent potential for being wonderfully resilient, if given adequate support and counseling. It is therefore extremely important to strengthen the child's communication and coping skills and to help mobilize people and other resources around the child. Efforts should be made to foster closeness, accessibility, and emotional availability. Having fun, reading to small children, and continuing the usual work, school, and social activities are important steps.

Returning to the family's routine as soon as possible is important and something that parents can control. Children of all ages thrive on structure and routine (as do most adults); familiar things and routines are reassuring and comforting. Children of all ages will respond positively to appropriate reassurance and a calm demeanor.

Children should be allowed to express their feelings about the recent disaster, and reassured that it is normal to feel upset. Giving more attention to children during the days after a disaster, not only for talks related to the disaster but also for other conversation or for just spending time together, is helpful.

Children can regain their sense of power and security if they feel they can help in some way. This can be accomplished by encouraging youngsters to participate in or organize a community response effort, such as sending cards, organizing food drives, or collecting clothing and other items.

### LONG-TERM EFFECTS

Most persons have experienced a severely traumatic event at some time; yet not everyone develops acute stress disorder or posttraumatic stress disorder. These terms are applied broadly to the development of multiple maladaptive thoughts, feelings, and behaviors in response to a traumatic or several traumatic life experiences.



When most or all of these symptoms are present and last for up to 4 weeks causing impairment in functioning, the term acute stress disorder is applied. When they continue for longer, it is called posttraumatic stress disorder. These symptoms can begin immediately after a trauma, or may have a delayed onset, not showing up until days or months later.

When should health care professionals or parents start to worry about the long-term mental health effects of trauma? Usually, a child's emotional response to a trauma does not last long. It is normal and expected to see children show the responses described above during the first few weeks after a trauma. However, some reactions may not appear immediately, or may recur weeks or months after the trauma. Concern is definitely warranted when emotional responses persist for long periods or are accompanied by significant functional impairment. In adolescents, for instance, seeking professional help should be considered if they demonstrate particular behaviors that interfere with daily activities in school or at home. These behaviors include agitation and apathy, risk-taking behaviors, poor concentration, avoidance, unusual aggression, disenchantment (ie, what's the point?), or feelings of hopelessness or helplessness. In deciding whether to seek professional help, consider the degree to which the observed behaviors represent a change subsequent to the traumatic event. Obtaining counseling for a child or adolescent soon after a disaster may reduce long-term negative effects.

## **MANAGING FAMILY CONCERNS ABOUT TERRORISM AND DISASTER PREPAREDNESS**

The pediatrician plays a central role in disaster and terrorism preparedness with families and children. Families view pediatricians as their expert resource, and most expect the pediatrician to be knowledgeable in areas of concern. Providing expert guidance entails both educating families in anticipation of events and responding to questions during and after actual events.

In many areas of the country, the threat of natural disasters is ongoing, and guiding and educating families on home disaster preparedness can be done in the pediatrician's office or as a community focus. Family preparedness may include training in cardiopulmonary resuscitation, rendezvous points, lists of emergency telephone numbers, and an out-of-state friend or relative to whom all family members can contact after the event to report their whereabouts and conditions. Home preparedness (such as installing storm shutters or earthquake proofing the home) should be covered. Parents should

maintain emergency supplies of food, water, medicine, a first-aid kit, and clothing. Family members should know the safest place in the home, make special provisions, know community resources, and have a plan to reunite. Medications for chronic illness and resources for children who depend on technologic means for survival should be included in the plan.

## **ANSWERING QUESTIONS DURING EVENTS**

During any event, children and families will receive good and bad information from a multitude of sources, including friends, media, and public officials. During any event, the problems caused by panic, overreaction, and overwhelming the health care system with the "worried well" cannot be understated. A well-educated and available pediatrician who can appropriately respond to numerous and varied questions can be of great service.

## **ADVICE FOR FAMILIES OF CHILDREN WITH SPECIAL HEALTH CARE NEEDS**

Pediatricians should also provide guidance to families of children with special health care needs. This may include the following:

- Notifying utility companies to provide emergency support during a disaster
- Maintaining a supply of medications and equipment in case availability is disrupted during a disaster
- Knowing how to obtain additional medications and equipment during times of a disaster
- Training family members to assume the role of in-home health care providers who may not be available during a disaster
- Keeping an up-to-date emergency information form to provide health care workers with the child's medical information in case the regular care provider is unavailable

## **OFFICE-BASED PREPAREDNESS**

After a disaster, offices or clinics may become sites for care if area hospitals are unable to provide services. Still, even local offices could become inaccessible or unusable, so that alternative sites for primary care must be identified. If necessary, medical care may be provided in schools, public buildings, malls, and or makeshift facilities such as tents using limited power and water sources. Pediatricians should prepare, regularly update, and practice an office disaster plan that addresses response and recovery issues. Office training programs in emergency procedures, including first aid, cardiopul-

monary resuscitation, evacuation, search and rescue, the use of fire extinguishers, and participation in community disaster drills should be a routine part of the office's overall emergency preparedness. It may be advisable for pediatricians to check local building codes to ensure that their office buildings meet current structural safety standards. Agreements with vendors may need to be obtained for operations after the disaster. Emergency kits should be assembled and contain water, first-aid supplies, radios, flashlights, batteries, heavy-duty gloves, food, and sanitation supplies.

The length of the recovery period depends on the nature of the disaster. Pediatricians should be prepared to deal with continued disruptions of services that will affect their ability to care for patients and should have plans to provide on-site emergency and primary health care at emergency shelters. Issues to be addressed include inpatient and outpatient treatment, infectious disease control alternatives for lost services and utilities, logistics and resupply physical rehabilitation, mental rehabilitation, and critical incident stress debriefing.

During the aftermath, changes in practice location, a lack of refrigeration for medications and vaccines, continued disruption of communications, power outages, and lack of sanitation will force changes in practice standards and require resourcefulness and flexibility. Assisting families coping with the emotional toll of the disaster may be an ongoing responsibility of the pediatrician.

Pediatricians in the community can assist in both triage and treatment of patients. Important questions to ask include (1) where should the pediatrician go during the disaster? (2) how should pediatricians be notified that they are needed to respond to the disaster? (3) how should hospital physicians be identified and notified to go to the scene to attend to victims of the disaster? and (4) how should transfers of pediatric patients in the hospital and discharges be handled? In addition, alternatives need to be considered in the event of a loss of power and conventional telephone use. Backup systems such as cellular phones, direct telephone lines that are not part of the regular telephone system, 2-way radios, beepers, and ham radios should be considered. In areas where pediatricians cover several hospitals, pools should be initiated through the county medical or pediatric society to provide uniform pediatric coverage of area hospitals. Pediatricians can aid schools and child care centers in developing disaster plans. In California, state law requires each state-licensed child care facility and all schools to develop and maintain a disaster and mass casualty plan.

## HOSPITAL PREPAREDNESS

The health care facilities responsible for treating pediatric patients in a biological or chemical event could be strained or overwhelmed. Medical facilities can become inundated with patients if large numbers of victims appear without ambulance transport and preentry notification. This situation differs markedly from existing hospital disaster alert systems in which patients are triaged in the field and carefully distributed among available resources to prevent any single facility from being overwhelmed. Along similar lines, patients appearing without full hospital preparation could thwart attempts to isolate contaminated victims from other patients and hospital staff. Large-scale biological or chemical incidents necessitate the use of alternative health care sites (eg, auditoriums and arenas), which require that pediatric health care resources be dispersed to areas where patients may not receive optimal care. Injuries to health care professionals in both office and in-hospital settings would dramatically diminish available medical resources.

Children are difficult to care for by persons wearing protective equipment, which is essential in the management of biological or chemical events. Protective clothing is bulky and cumbersome; it impedes the ability of persons to perform procedures such as venipuncture on small children. Because these garments are not ventilated, profuse sweating occurs. Dramatic fluid losses and dehydration also may occur. In warm ambient temperatures, hyperthermia may develop.

### THE HOSPITAL EMERGENCY/DISASTER RESPONSE PLAN

Hospitals are increasingly concerned about how to deal with disaster or terrorist events. The hospital emergency/disaster response plan is a critical document in ensuring that the hospital or medical facility is prepared to respond. It describes the policies and guidelines to follow in the event of an emergency such as a disaster or terrorist event, and it should be reviewed frequently to ensure that all information is up-to-date and accurate. Requirements of such plans are specified, in part, by the Joint Commission for the Accreditation of Healthcare Organizations *Accreditation Manual for Hospitals*, national fire codes, the community emergency preparedness plan, community fire and sanitation ordinances, and applicable state and federal regulations.

Although each plan is individualized to the hospital, common elements of all plans should include:

- Roles and responsibilities of the hospital and staff
- Organizational and reporting structure in an emergency

- Fire plan
- Guidelines and policies for access to emergency care areas
- Communications systems alternatives (when main communication systems fail)
- Guidelines to follow when electrical, air conditioning, plumbing boiler systems, and essential life support systems fail
- Guidelines for patient management (scheduling, modification discontinuation of services, control of patient information, and admission, transfer, and discharge of patients)
- Evacuation plan
- Special equipment requirements (for hazardous materials incidents)

Physicians should also be familiar with the chain of command and organization during hospital emergency responses. Many hospitals have adopted the Hospital Incident Command System—a system of unified command and authority during emergencies that uses terminology and organization similar to those used by other responders. This is the hospital equivalent of the Incident Command System (see below) used by responders in the community and at the state and federal levels.

## COMMUNITY, GOVERNMENT, AND PUBLIC HEALTH PREPAREDNESS

Emergency preparedness is important at many levels—personal, family, community, regional, state, and federal—with the state and federal governments having pivotal roles. The federal government provides significant funding for disaster preparedness and response and also, to a large extent, establishes the framework that is then followed by states, regions, and communities. In disaster response the funding and planning tend to be from the top down, whereas the response and use of resources tend to be from the bottom up. In other words, as resources are exhausted at the local level, assistance is requested from the next level, such as the state, which then requests federal assistance. Volunteer organizations, such as the Red Cross and Salvation Army, also have key roles in disaster response. Recent concepts of disaster and aftermath response and planning include the involvement of neighborhoods and families, and even have begun to address needs at the individual level. A successful response to a disaster requires the interaction of personnel and resources from multiple agencies in an organized and coordinated manner according to a well-formulated plan. Although this planning has increased in recent times, the attention to the unique needs of children and the

inclusion of pediatric expertise in the planning phases are still lacking or in many cases nonexistent.

## COMMUNITY RESPONSE

Local governments are the first line of defense in emergencies and are primarily responsible for managing the response to most disasters. The primary responsibility for the protection of citizens belongs to such local elected officials as mayors, city councils, and boards of commissioners. When a local government receives a warning that an emergency could be imminent, its first priorities are to warn citizens and to take whatever actions are needed to minimize damage and protect life and property. If necessary, an evacuation may be ordered. The emergency operations plan is at the center of comprehensive emergency planning. This plan spells out the scope of activities required for community response. It needs to be a living document that accurately describes what the community can realistically do. Unfortunately, these documents rarely contain any pediatric considerations and in only the rarest of cases have pediatricians been part of the planning process.

When a local government responds to an emergency, the level of response and the types of resources required are determined by several factors, including the following:

- Speed of onset of the emergency
- Potential need for evacuation
- Magnitude of the situation
- Projected duration of the event
- Extent of threat to the citizens

## STATE GOVERNMENT

All states have laws that describe the responsibilities of the state government in emergencies and disasters. These laws provide governors and state agencies with the authority to plan for and carry out the actions necessary to respond to and recover from emergencies. State emergency management legislation describes the duties and powers of the governor, whose authority includes the power to declare a state of emergency and to decide when to terminate this declaration.

Performing and maintaining the provisions of emergency management legislation is generally the responsibility of the state emergency management offices (some municipalities also have offices of emergency management). These offices are organized in a number of ways and have different names. Emergency managers are responsible for preparing for emergencies and for coordinating the activa-



tion and use of resources controlled by the state government when they are needed to help local governments respond to and recover from emergencies and disasters. In its coordinating role, the state emergency management office is involved in virtually all serious emergencies, terrorism, or disasters. Using procedures specified in the state emergency operations plan, the state emergency management organization coordinates deployment of personnel and resources to the affected areas. Again, pediatric concerns have rarely been considered. In a recent Federal Emergency Management Agency (FEMA) study, it was found that none of the states' emergency operations plans had guidelines specific to children. We are currently addressing these concerns via a federal grant to create a model pediatric component for state disaster plans. In addition to this effort, pediatricians will need to become involved in the state emergency planning committees to ensure that not only are pediatric considerations included in state plans, but also that they become part of the plans of each state agency and part of funding for disaster and terrorism preparation. Pediatricians can be involved both through grass roots efforts and through involvement in professional organizations such as chapters of the local American Academy of Pediatrics.

### FEDERAL GOVERNMENT

The authority of the federal involvement in disasters is based on provisions of the Stafford Act. This act establishes the presidential declaration process for major disasters and emergencies, provides for the implementation of disaster assistance, and sets forth the various disaster assistance programs. Federal agencies involved in disaster relief planning include FEMA, the Department of Transportation, the Department of Defense, the Department of Housing and Urban Development, and the Federal Aviation Administration among others.

Once the President declares a federal emergency or disaster FEMA assumes several roles:

- Provides Disaster Medical Assistance Teams (DMATs) through the National Disaster Medical System
- Helps state governments request additional types of disaster assistance
- Evaluates requests for additional assistance
- Implements disaster assistance programs
- Coordinates the delivery of federal assistance from federal agen-

cies and voluntary organizations under the Federal Response Plan (FRP)

- Continues to manage the President's Disaster Relief Fund

The role of FEMA is to coordinate the delivery of federal assistance by managing its own programs and by coordinating disaster assistance from other federal departments and agencies. FEMA coordinates these activities by using the interagency federal response system, also called the FRP. The FRP describes the basic mechanisms and structures by which the federal government mobilizes resources and conducts activities to augment state and local response efforts. To facilitate the provision of federal assistance, the FRP uses a functional approach to group the types of federal assistance that a state is most likely to need under the 12 Emergency Support Functions (ESFs). Each ESF is headed by a primary agency that has authorities, resources, and capabilities in the particular functional area. Other agencies have been designated as support agencies for one or more ESFs based on their resources and capabilities to support the functional area. The FRP is important in that the structure and some content of most state emergency operations plans are based on it. In turn, local emergency operations plans are then based on these state plans.

### Role Of Physicians

One of the major functions physicians will be involved with and should become familiar with is ESF Number 8, The Health and Medical Services Function. Health and Medical Services provides assistance to supplement state and local resources for public health and medical care needs during a disaster. In a federally declared disaster, the Department of Health and Human Services of the US Public Health Service forms a Crisis Action Team and activates the National Disaster Medical System as needed to provide health and medical care assistance. A DMAT is a deployable unit of 35 physicians, nurses, technicians, equipment, and supplies for austere medical care. A Management Support Unit manages field health and medical resources of deployed DMATs. A Disaster Mortuary Assistance Team provides a temporary morgue facility, victim identification, processing, preparation, and disposal of remains. A Metro Medical Strike Team provides assistance in the medical treatment and management of chemical, biological, or radiologic incidents resulting from deliberate or accidental acts. The parent agency of all of these groups is the US Public Health Service.



### THE INCIDENT COMMAND SYSTEM

In all emergencies, there may be varying levels of response from a multitude of agencies and from multiple governmental levels. To ensure a unified command, clear communication, and common terminology, the federal government, most states, and many localities have adopted the Incident Command System (ICS), which provides for the following:

- Functional organization
- Standardized operating structures
- Organizational flexibility
- Common terminology
- Training and credentialing

In addition to its use in many emergency response functions, the ICS has been adopted by many hospitals. The ICS has been crafted to reflect hospital responsibilities and needs in the form of the Hospital ICS (see above). As we become more conscious of emergency preparedness and more hospitals adopt this system, physicians will need to be educated on its usage and their role in it.

### PUBLIC HEALTH PREPAREDNESS

On a larger scale, we must also recognize the need for public health preparedness. This requires the existence of a strong public health system. To allow for a rapid and an efficient response, this requires both central organization as specified by federal planning and state implementation, and decentralization of some resources, such as diagnostic capabilities.

Pediatricians must understand the importance of public health and their relationship to departments of health. This includes their role in public health, reporting requirements and mechanisms, and mechanisms for receiving and soliciting information from departments of health.

### ADVOCATING FOR CHILDREN AND FAMILIES IN PREPAREDNESS PLANNING

As all pediatricians know, children are often overlooked in government and community activities for a multitude of reasons. Properly informed and motivated pediatricians are essential advocates for children. This role can take several forms. Grass roots advocacy can include efforts to encourage legislation and funding that consider the needs of children in disaster planning at every level. Pediatricians can also serve as expert advisors to local, state, and federal agencies and committees. Most often, this can be through involve-

ment in professional organizations such as the American Academy of Pediatrics and its local chapters, and other special committees and task forces. Pediatricians should:

- Advocate for inclusion of the needs of children in all federal, state, and local disaster planning
- Advocate for research on the pediatric aspects of biological, chemical, and radiologic terrorism, including mechanisms, pathophysiology, and treatments. This includes availability of appropriate medications and antidotes.
- Work with DMATs to ensure that they are equipped and trained for the care of children
- Assist in developing a hospital disaster plan that ensures the proper care of children
- Provide on-site emergency and primary health care at emergency shelters
- Be involved in emergency medical services (EMS); for example, develop proficiency in cardiopulmonary resuscitation and first aid, train first responders in pediatric assessment, assist in development of prehospital pediatric protocols, help establish protocols for consent to treat and identification of minors, and ensure the availability of pediatric resources.

At the local and community level, pediatricians should:

- Work with local police, fire, and EMS departments to ensure their plans and equipment are prepared for children
- Be involved with local and community emergency preparedness task forces and committees
- Work with schools, child care centers, and other locations where children spend their time to ensure that they have adequate emergency plans

Similarly, at the state level, pediatricians should:

- Ensure that state emergency management, department of health, and EMS advisory committees have pediatric expertise as part of their membership
- Advocate for all state disaster and terrorism education and funding to require incorporation of children's needs

### CONCLUSION

One of the first steps to address terrorism preparedness for children is to reinforce the legitimate need for pediatricians to become involved and informed about relevant issues. In addition, pediatric

training programs need to consider formalizing a curriculum focused on terrorism, emergency response, and the role of the pediatrician in disaster management, including information on how weapons of terror affect children psychologically as well as medically.

A clear research agenda is being developed to examine these and other crucial areas of concern. The fact is that reliable data on children are scant, and pediatricians must often rely on clinical experience and extrapolation from adult studies. Yet both approaches have significant limitations. Although testing of new medications and therapeutics is rarely done in children, it has not been done at all for antidotes or preventive agents for terrorist events. Funding is needed to conduct research that addresses vaccines, resistance, antidotes, pediatric dosing recommendations, resilience, and mental health considerations. Disaster and terrorism preparedness must become an integral part of the scope of academic pediatric activities, including both education and research.

A crucial element of preparedness for health professionals is developing a comfort level with the ability to respond in an emergency and the capacity to problem-solve under duress and in unique circumstances. In addition, the didactic information pertaining to particular threats may change unexpectedly as new research or experience is gained. Therefore, a mechanism for continued learning in this area is essential. Government agencies, academic centers, and specific organizations may provide updated information via written materials, conferences, and on the World Wide Web.

These issues will also need to be incorporated into the teaching curricula of medical schools and academic medical centers. This will represent a new academic agenda of training and research around terrorism, disasters, and emergency response designed for medical students and residents. In addition, this new curricula should become core to continuing medical education efforts, including grand rounds, departmental lectures, journal articles, sessions at national meetings, sessions during resuscitation courses, and required components in recertification and licensure of pediatricians.

There is a significant potential for inequitable distribution of information and resources with respect to terrorism and disaster preparedness. Just as traditional health and public health resources are often relatively unavailable or inaccessible in underserved communities, it would be reasonable to expect the same patterns in the distribution of resources for these new challenges. Pediatricians need to be vigilant about such possibilities and be prepared to advocate

appropriately for underserved communities, as well as for children in general.

In addition to their traditional roles of child health expert, advocate for children, community provider, family resource, and a force behind new research, pediatricians must now take on new roles regarding disaster and terrorism preparedness. Information, education, and participation are important initial steps for all pediatric health professionals.

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## APPENDIX

## SUGGESTED RESOURCES FOR FURTHER INFORMATION

**American Academy of Pediatrics****Publications**

Committee on Environmental Health and Committee on Infectious Diseases: Chemical-biological terrorism and its impact on children. *Pediatrics* 105:662-670, 2002.

Balk SJ, Miller RW: FDA issues KI recommendations. *AAP News* 20(3):99, 2002.

Wolraich ML, Aceves J, Feldman HM, et al: How pediatricians can respond to the psychosocial implications of disasters. *Pediatrics* 103:521-523, 1999.

Committee on Pediatric Emergency Medicine and Committee on Medical Liability: Pediatricians' liability during disasters. *Pediatrics* 106:1492-1493, 2000.

Committee on Psychosocial Aspects of Child and Family Health: The pediatrician and child bereavement. *Pediatrics* 105:445-447, 2000.

Committee on Infectious Diseases: The smallpox vaccine. *Pediatrics* 110:841-845, 2002.

Committee on Environmental Health: Radiation disasters and children. *Pediatrics* 111:1455-1466, 2003.

**Informational Documents**

*Child With a Suspected Anthrax Exposure or Infection*

*Anthrax/Bioterrorism Q&A*

*AAP Offers Advice on Communicating With Children About Disasters*

*AAP Responds to Questions About Smallpox and Anthrax*

*AAP Experts Address Smallpox Questions*

*Family Readiness Kit: Preparing to Handle Disasters*

*Responding to Children's Emotional Needs During Times of Crisis: An Important Role for Pediatricians*

*Smallpox: Frequently Asked Questions—Parent Handout*

*Terrorism: A Family Disaster Plan*

*The Youngest Victims: Disaster Preparedness to Meet Children's Needs*

[www.aap.org/terrorism](http://www.aap.org/terrorism)

**American Red Cross**

[www.redcross.org](http://www.redcross.org)

**Centers for Disease Control and Prevention**

[www.bt.cdc.gov](http://www.bt.cdc.gov)

**Children's Health Fund**

Redlener I, Grant R: The 911 terror attacks: Emotional consequences persist for children and their families. *Contemp Pediatr* 19(9):43-59, 2002.

[www.childrenshealthfund.org](http://www.childrenshealthfund.org)

**Federal Emergency Management Agency**

[www.fema.gov](http://www.fema.gov)

**Program for Pediatric Preparedness, National Center for Disaster Preparedness**

*Executive Summary from Pediatric Preparedness for Disasters and Terrorism: A National Consensus Conference, 2003.*

*Report of Pediatric Preparedness for Disasters and Terrorism: A National Consensus Conference, 2003.*

[www.pediatricpreparedness.com](http://www.pediatricpreparedness.com)