AMERICAN ACADEMY OF PEDIATRICS

Committee on Environmental Health and Committee on Infectious Diseases

Chemical-Biological Terrorism and Its Impact on Children: A Subject Review

ABSTRACT. There is an increasing threat that chemical and biological weapons will be used on a civilian population in an act of domestic terrorism. Casualties among adults and children could be significant in such an event. Federal, state, and local authorities have begun extensive planning to meet a chemical-biological incident by developing methods of rapid identification of potential agents and protocols for management of victims without injury to health care personnel. Because children would be disproportionately affected by a chemical or biological weapons release, pediatricians must assist in planning for a domestic chemical-biological incident. Government agencies should seek input from pediatricians and pediatric subspecialists to ensure that the situations created by multiple pediatric casualties after a chemical-biological incident are considered. This statement reviews key aspects of chemical-biological agents, the consequences of their use, the potential impact of a chemical-biological attack on children, and issues to consider in disaster planning and management for pediatric patients.

ABBREVIATION. CDC, Centers for Disease Control and Prevention.

The release of the nerve agent sarin in a Tokyo subway in 1995 focused the world's attention on the reality of chemical or biological weapons use on a civilian population. In that incident the intentional use of this nerve gas resulted in injury to more than 5000 adults and children, with 12 deaths. In the same year, the Federal Bureau of Investigation uncovered a terrorist effort to release a chlorine gas bomb in the Disneyland theme park in California. Recent confiscations of anthrax bacteria and the plant toxin ricin from US civilians have firmly established chemical and biological terrorism as a growing environmental threat.[1] Agents that were created for wartime use are increasingly being sought by civilian groups who seek revenge, publicity, reaction, and chaos.[2]

According to the Centers for Disease Control and Prevention (CDC), one of the most imminent terrorist threats is the release of a "weaponized" chemical or biological agent.[3] Despite international accords such as the Biological and Toxin Weapons Convention of 1972, designed to prevent further proliferation of biological weapons, these and other compounds continue to be developed as weapons of mass destruction.[4,5] In response, federal legislation has been created to reduce the possibility of weapons use on civilians.[6] There has also been a widespread effort by military, government, and public health officials to initiate appropriate management protocols for mass casualty incidents. A chemical-biological attack would affect civilians of all ages, including children. Events such as the unsuccessful release of a gas bomb at Disneyland indicate that terrorist acts may be directed specifically at children.

AGENTS OF CONCERN

Chemicals

Table 1 lists the classes of chemical agents that have been used or are considered likely candidates for use in a chemical release. 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.[7] Many of these agents are "weapons of opportunity" confiscated from industry or transport vehicles rather than manufactured by terrorists.

Nerve agents are highly toxic; as little as 1 mg can be lethal to an adult.[8–10] Most nerve agents are highly volatile and are 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 makes it easier to breathe by children because it is concentrated closer to the ground.

Sarin has been made infamous by 2 recent, large-scale acts of civilian terrorism. In June 1994 and March 1995, a terrorist group in Japan released the nerve agent into the subway system.[11–16] In the 1995 incident, casualties were extensive and included 16 children younger than 18 years and 5 women who were pregnant (Okumura, Tetsu, MD, personal communication, July 14, 1998).[11] Ten percent of prehospital personnel, including police and paramedics, experienced symptoms of nerve agent poisoning as a result of exposure to victims and the contaminated environment.[16] As many as 46% of the hospital staff became symptomatic through improper handling of victims. Less than 10% of the more than 5000 victims came to hospitals via ambulance; the remainder of victims arrived unexpectedly via taxi, automobile, or on foot.[16]

Because nerve agents are well-absorbed through intact skin, treatment begins with safe, topical decontamination.[17,18] Protection of health care personnel is

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

TABLE 1. Potential Chemical Agents for Use in Chemical-Biological Terrorism[3,8–10]

Class	Examples	Diagnostic Aids	Interventions*	Antidotes
Nerve agents	Tabun Sarin Soman VX	Plasma, red cell cholinesterase	Respiratory support, skin decontamination	Atropine, pralidoxime, diazepam
Vesicants	Mustard gas Nitrogen mustard	Air sampling	Respiratory support, skin and eye decontamination	
Irritants/corrosives	Chlorine Bromine Ammonia	Air sampling	Respiratory support, skin and eye decontamination	Nebulized albuterol
Choking agents	Phosgene	Air sampling	Respiratory support	
Cyanogens	Hydrogen cyanide	Blood or serum analysis	Cardiorespiratory support	Amyl nitrate, sodium nitrite, sodium thiosulfate
Incapacitating agents				
Central nervous system depressants	Cannabinoids Barbiturates	Blood or serum analysis	Respiratory support	
Anticholinergics	3-Quinuclidinyl benzilate (BZ)			Physostigmine
Lacrimators	Capsaicin			

* 1. Skin decontamination is performed by showering victims unclothed in warm water for 8 to 10 minutes.
2. Standard equipment for infection control (gloves, masks, gowns) is ineffective in protecting health care workers. Avoid contact with victims and their clothing until personal protective gear is obtained.
3. Clothing should be considered hazardous waste and safely discarded.

key in decontamination. Standard equipment used for universal precautions (eg, surgical masks and latex gloves) does not provide protection from nerve agents; health care workers must wear full protective gear and self-contained breathing apparatus. Solutions such as soap and water or dilute bleach are recommended for removal of these chemicals from skin.[12] Additional management includes supportive care and, in severe cases, administration of atropine and pralidoxime.[9]

Mustard gas, ammonia, and chlorine are corrosive chemicals that may be used in a chemical-biological incident. They are designed to injure skin, eyes, and nasal mucosa, producing severe pain and incapacitation. If these chemicals are inhaled, life-threatening pneumonitis may also occur. With agents such as these, skin decontamination by showering is the mainstay of therapy (Table 1). Pulmonary support including intubation and mechanical ventilation may be necessary for those with severe pulmonary injury.

Other chemical agents listed in Table 1 are designed to incapacitate rather than kill. However, particularly in victims with significant chronic illness, the incapacitating agents can result in life-threatening toxicity.

Biological Agents

Biological weapons are referred to as a "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.[4,19] Simple devices such as crop dusting airplanes or small perfume atomizers are effective delivery systems for biological agents.[2,4] 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 (hours to days).[1] Moreover, illnesses from biological weapons are likely to be unrecognized in their initial stages. With highly transmissible agents (eg, plague and smallpox), the time delay to recognition can result in widespread secondary exposure to others, including health care personnel. Depending on the communicability of the microbe, wide geographic paths can be affected when infected individuals who are asymptomatic travel by airplane to other parts of the country or world.

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.[13,20] An inadvertent release of anthrax in April 1979 by a military facility in Sverdlovsk, USSR, produced mass infection as distant as 50 km, with 66 documented deaths.[13,21,22]

Table 2 lists biological agents considered to be likely candidates for weaponization. These agents include bacteria, viruses, or preformed toxins, and for most, quantities as small as 1 kg can injure or kill thousands of people. Marked diversity exists in the type of injury produced by infectious agents, with toxic effects ranging from incapacitation to death.

Anthrax has been extensively developed as a biological weapon and is considered the most likely candidate for a biological release.[5,23] The causative organism, *Bacillus anthracis*, is a Gram-positive sporulating rod. Because its initial symptoms are nonspecific and experience with the disease is uncommon, anthrax may be misdiagnosed.[22] The first indication of an aerosol exposure may be groups of patients presenting with severe influenza-like disease with a high case-fatality rate.[23] After a few hours or days and the possible appearance of improvement in affected individuals, progression to fever, dyspnea, and shock occurs. A widened mediastinum consistent with lymphadenopathy or hemorrhagic mediastinitis occurs commonly. Usually no evidence

TABLE 2. Potential Candidates for Biological Weapons Development[2,19,24]

Bacteria
Bacillus anthracis (anthrax)
Brucella abortus, B melitensis, B suis
Burkholderia mallei, B pseudomallei
Clostridium botulinum (botulism)
Francisella tularensis (tularemia)
Yersinia pestis (plaque)
Viruses
Congo hemorrhagic fever
Eastern equine encephalitis
Ebola virus
Equine morbilli virus
Lassa fever virus
Marburg virus
Rift Valley fever virus
South American hemorrhagic fever
Tickborne encephalitis complex
Variola (smallpox)
Venezuelan equine encephalitis virus
Hantavirus
Yellow fever virus
Rickettsia
Coxiella burnetii (Q fever)
Rickettsia prowazekii (epidemic typhus)
Rickettsia rickettsii (Rocky Mountain spotted fever)
Fungi
Coccidioides immitis (coccidiodomycosis)
Toxins
Abrun
Aflatoxin
Botulinum toxins
C perfringens epsilon toxin
Conotoxin
Diacetoxyscirpenol
Ricin
Saxitoxin
Shiga toxin
Staphylococcal enterotoxin
Tetrodotoxin
T2 toxin
Microcystins

of bronchopneumonia exists. Human-to-human transmission of anthrax does not occur.[24]

Plague, caused by *Yersinia pestis,* is also considered a potential bacterial weapon. Unlike anthrax, pneumonic plague can be highly contagious, quickly infecting families or health care professionals. Untreated, plague carries a mortality as high as 100%.[19]

Other bacterial agents with high potential for use as biologic weapons are *Brucella* species (brucellosis), *Coxiella burnetii* (Q fever), and *Francisella tularensis* (tularemia). Table 3 summarizes the recommended management for these and other biological agents.

Viruses of concern include variola (smallpox), Ebola, and other hemorrhagic viruses and the viral encephalitides.[1] Because smallpox was eradicated globally in 1980, and children are no longer being immunized,[19] more than 80% of the adult population and 100% of children are susceptible to the virus.[1] Smallpox produces a characteristic centrifugal rash consisting of vesicles with umbilicated centers. The rash, once familiar to clinicians, is now unlikely to be recognized quickly and can be mistaken for varicella. Reported mortality from smallpox ranges from 3% to 30%, respectively, in individuals who have or have not been immunized.[25]

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, one of the most potent toxins known, can be extracted from the bacterium *Clostridium botulinum*; highly potent, it is 100 000 times more toxic than sarin.[19,25] Within 1 to 3 days of exposure, victims experience cranial nerve disturbances followed by descending paralysis and respiratory failure. The enterotoxin of *Staphylococcus aureus* is also incapacitating although not highly lethal, except in those at extremes of age or with chronic illness. Exposure to this toxin can produce severe diarrhea that results in marked fluid losses and frank shock.[25] Ricin and aflatoxin are plant-derived toxins. Ricin, a potent toxin obtained from *Ricinus communis*, the castor bean,[26] was developed as a chemotherapy agent[27] but has been used in assassinations.[2] Inhalation of ricin produces weakness, fever, cough, and pulmonary edema within 24 hours, with death from hypoxemia occurring in 36 to 72 hours.[19] When ingested, ricin produces severe vomiting and diarrhea, resulting in cardiovascular collapse. Treatment is supportive; there is no antidote.

ROUTES OF EXPOSURE, EARLY SYMPTOMS

Acts of chemical-biological terrorism use various routes of exposure.[8,9,19] Inhaled airborne agents may produce toxicity by introducing infection via the respiratory tract (eg, anthrax, smallpox), by producing lung injury (eg, chlorine), or by their absorption with resulting systemic effects (eg, cyanide). Aerosolized agents may also be designed to produce skin injury (eg, vesicants, corrosives). Finally, aerosolized agents can be designed for absorption through the skin with resulting systemic effects (eg, VX and other viscous nerve agents).[8]

Ingestion of contaminated food or water is another important route of exposure. Many biological agents are efficiently introduced via this route. For example, as few as 100 *Shigella dysenteriae* bacteria can produce severe bacterial enteritis.[28]

Early signs and symptoms of illness from chemical or biological weapons are often unrecognized by health care professionals. For example, mild exposure to nerve agents may produce only nausea, vomiting, and weakness. Many biological agents initially cause only fever or a flu-like illness. Table 4 outlines many of the early clinical manifestations after exposure to chemical-biological agents.

ENVIRONMENTAL CONSEQUENCES OF CHEMICAL-BIOLOGICAL INCIDENTS

The environmental toll of a chemical or biological toxin release can be comparable to that from nuclear fallout. Depending on the agent, local areas can become uninhabitable for days to months. In the case of anthrax, the ability of the bacterium to sporulate can result in soil contamination by spores that remain viable for more than 30 years.[19,23] Viscous nerve agents such as VX also have significant environmental persistence, leading to area contamination that prevents families from returning to their homes.[29]

TABLE 3. Biological Weapons: Recommended Diagnostic Procedures, Isolation, and Treatment in Children[16,43]

Agent	Incubation Period	Diagnostic Sample(s)	Isolation Precautions*	Treatment Options†	Prophylaxis‡	Comments
Anthrax	1–60 d	Blood culture, blood smear; skin lesions or tissue, culture or fluorescent antibody (FA) staining	Standard, contact for skin lesions	Ciprofloxacin§ or doxycycline‖ or (penicillin G and streptomycin)¶, vaccine, if available (see text)	Ciprofloxacin§ or doxycycline‖	Alternate agents: gentamicin, erythromycin, chloramphenicol
Brucellosis	5–60 d	Blood or bone marrow, culture, acute/convalescent sera	Standard, contact if lesions are draining	Doxycycline and rifampin; if <8 y, trimethoprim-sulfamethoxazole	Doxycycline and rifampin	Trimethoprim-sulfamethoxazole may substitute for rifampin with doxycycline
Plague	2–3 d	Blood, sputum, lymph node aspiration, culture or FA staining	Droplet	Streptomycin or gentamicin, doxycycline or chloramphenicol	Doxycycline, tetracycline	Trimethoprim-sulfamethoxazole is alternative; chloramphenicol for meningitis
Q fever	10–40 d	Acute/convalescent sera	Standard	Doxycycline or tetracycline	Doxycycline, tetracycline	
Tularemia	2–10 d	Sputum or tissue, culture#, FA available, acute/convalescent sera	Standard	Streptomycin or gentamicin	Doxycycline, tetracycline	
Smallpox	7–17 d	Pharyngeal swab or lesions, culture	Airborne, contact	Cidofovir**	NA (vaccine effective but not available)	
Botulism	1–5 d	Serum for toxin if <3 d; stool or gastric secretions, culture for organism and look for toxin; nerve conduction	Standard	Antitoxin (CDC††)	If ingested, induced vomiting, gastric lavage, purgation and high enemas may benefit	Aminoglycosides potentiate paralysis; antitoxin after exposure for asymptomatic not usually given
Staphylococcal enterotoxin B	1–6 h	Nasal swab, culture serum and urine for organism and look for toxin	Standard	Supportive care	NA	
Ricin					NA	

* For decontamination guidelines, see text.
† See the Report of the Committee on Infectious Diseases (*Red Book*) 24th ed, 1997 (or the most current edition) for drug doses. Intravenous therapy for severely ill patients is usually indicated, but oral therapy can be effective and may be the only practical alternative when large numbers of people are exposed.
‡ Prophylaxis should only be initiated after consultation with public health officials in situations where exposure is highly likely. The duration of prophylaxis has not been determined for most agents.
§ If susceptibility unknown. Ciprofloxacin is not FDA approved for persons <18 years of age, but is indicated for potentially serious or life-threatening infections (see *Red Book*).
‖If susceptibility unknown. Tetracyclines, including doxycycline, are not FDA approved and usually contraindicated in children less than 8 years, but treatment is warranted for selected serious infections (see 2000 *Red Book*).
¶ Penicillin should be used only if the organism is known to be susceptible.
# Special media required for culture, laboratory hazard: only immunized technicians should ordinarily process cultures.
** Pediatric dose not established.
†† Centers for Disease Control and Prevention Drug Service. 404/639-3670 (weekdays, 8–4:30 ET) or 404/639-2888 (weekends, evenings, holidays).

TABLE 4. Prominent Early Clinical Manifestations After Exposure to Chemical-Biological Agents*

Manifestations†	Agents
Respiratory	
Flu-like illness	Q fever, smallpox, tularemia, Rocky Mountain spotted fever Ebola, Lassa fever
Pharyngitis	Anthrax
Dyspnea and stridor	Phosgene, Q fever, Hantavirus, tularemia, plague
Pneumonitis	Nerve agents
Bronchospasm	
Dermatologic	
Vesiculation‡ petechiae, purpura, or bullae‡	Smallpox, Ebola, Lassa fever, Hantavirus, Rocky Mountain spotted fever
Ulcers	Anthrax, tularemia
Corrosive injury/burns	Mustard gas, chlorine, ammonia
Cardiovascular	
Collapse, shock	Ricin, hantavirus
Bradyarrhythmias	Nerve agents
Hematologic	
Hemorrhage	T2 toxin
Neurologic	
Peripheral	
Weakness, hypotonia	Nerve agents, botulism
Fasciculations	Nerve agents
Central	
Apathy, disorientation, coma	Ebola
Seizures	Nerve agents
Meningitis	Anthrax
Renal	
Oliguria	Hantavirus
Gastrointestinal	
Rebound tenderness	Anthrax
Hematemesis, melena	Anthrax
Diarrhea	Shiga toxin, staphyloccal enterotoxin

* This table does not include all the agents listed in Table 2. Only those agents believed most likely to be used in a chemical-biological attack are included.
† The spectrum of clinical manifestations for many of these agents can be protean. The symptoms and signs noted in this table are those that would likely make someone initially seek medical attention and are based on the route of exposure during an attack (eg, the manifestations of anthrax differ for an inhalation versus food-borne exposure). Fever, headache, vomiting, and diarrhea are common early manifestations of many illnesses.
‡ Many of the diseases that cause petechiae or vesicular skin lesions will initially start as macular and/or papular rashes.

SPECIAL VULNERABILITIES IN CHILDREN

The release of chemical or biological toxins would disproportionately affect children through several mechanisms. With aerosolized agents (eg, sarin, chlorine, or anthrax), the higher number of respirations per minute in children results in exposure to a relatively greater dosage.[30] The high vapor density of gases such as sarin and chlorine places their highest concentration close to the ground in the lower breathing zone of children.[30] The more permeable skin of newborns and children in conjunction with a larger surface-to-mass ratio results in greater exposure to transdermally absorbed toxicants. Vesicants and corrosives produce greater injury to children because of their poor keratinization.[13] Children, because of their relatively larger body surface area, lose heat quickly when showered. Consequently, skin decontamination with water may result in hypothermia unless heating lamps and other warming equipment are used. Having less fluid reserve increases the child's risk of rapid dehydration or frank shock after vomiting and diarrhea. Finally, children have significant developmental vulnerabilities. Infants, toddlers, and young children do not have the motor skills to escape from the site of a chemical-biological incident. Even if they are able to walk, they may not have the cognitive ability to decide in which direction to flee. All children are at risk of psychological injury such as posttraumatic stress disorder from experiencing or living under the threat of chemical-biological terrorism.[31,32] In a mass casualty incident, children witness injuries and deaths, possibly of their parents, which would produce both short- and long-term psychological trauma ("psychiatric casualties").[31]

The health care facilities responsible for treating pediatric victims in a chemical-biological event could be strained or overwhelmed.[1] 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 victims are triaged in the field and carefully distributed among available resources to prevent any single facility from being overwhelmed. Along similar lines, victims appearing without full hospital preparation could thwart attempts to isolate contaminated victims from other patients and hospital staff. Large-scale chemical-biological incidents necessitate the use of alternative health care sites (eg, auditoriums and arenas), which requires that pediatric health care resources be dispersed to areas where victims could 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 chemical-biological events.[29] 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.[8]

PREPARATION FOR A CHEMICAL-BIOLOGICAL EVENT

The threat of chemical-biological terrorism has forced an extensive examination of existing resources.[1,33] The passage of the 1996 Defense Against Weapons of Mass Destruction Act has led to a more integrated relationship between public health and military organizations. Model cities have been designated as training sites under the Departments of Defense and Justice.[4] The Department of Defense is also working to develop emergency response teams that could be activated after a chemical-biological event.[1,34] Disaster medical assistance teams consisting of physicians, nurses, prehospital personnel, and other specialists have also been created; these (as well as disaster mortuary teams) can be mobilized when needed. Under the existing structure, the Federal Bureau of Investigation and the Federal Emergency Management Agency take lead roles in managing chemical-biological events ("consequence management"). These agencies work closely with other federal agencies, including the Departments of Defense, Energy, Transportation, Agriculture, Health and Human Services (including the Food and Drug Administration) and the Environmental Protection Agency.[29] The Public Health Service is able to activate the National Disaster Medical System and its 3 components (prehospital care, hospital evaluation, and inpatient care).[29] The National Disaster Medical System also assists in the deployment of teams from military bases or coordination centers (eg, the CDC).

Despite the establishment of new integrated systems, further training for a chemical-biological event is necessary. In a recent simulated chemical weapons release in New York City, first-responders entered the site without protective gear, exposing themselves to the toxin, risking illness, death, and secondary spread to others.[29] In contrast, preparation for the 1996 Olympic games included stockpiling of antibiotics and antidotes, demonstrating an ability to mobilize resources for a potential chemical-biological event when there is advance notice.[3]

At the community level, planning for chemical-biological catastrophes begins with the development of local health resources.[18,33–37] With chemical releases, unlike biological events, clinical effects can occur within minutes to hours, preventing the use of out-of-state resources (eg, disaster medical assistance teams). All prehospital personnel must be educated to recognize contaminated regions, use protective gear, triage pediatric patients, and use techniques of field decontamination.[13] Protective gear should be available in adequate supply.[16] Pediatric health care facilities need to develop protocols for isolation and decontamination of victims, mobilizing additional staff, and potentially using secondary care sites (eg, school auditoriums).[3] Protocols for safe in-hospital care must be established to prevent injury to health care personnel and other patients. This preparation includes creation of reverse-ventilation isolation areas and decontamination showers with separate water collection systems.

Because children spend the majority of their day in school, community preparation for the chemical-biological threat should include the local educational system. Plans for rapid evacuation or the identification of in-school shelters should be established. Schools may also become a necessary site for triage and treatment of pediatric casualties, requiring that community planning include this possibility.

Children exposed to chemical or biological agents are likely to require topical decontamination by showering.[35] Fig 1 illustrates a decision tree for determining whether to perform decontamination. The role of surface decontamination for individuals exposed to infectious agents has not been carefully evaluated. Decisions to be made after exposure to infectious agents are more difficult than those after exposure to chemical agents or toxins because symptomatic individuals are not likely to present for hours or days after exposure. Whether or not to use decontamination procedures for asymptomatic individuals after a known or suspected exposure is a decision that must be made before the agent has been identified. If no symptoms have developed within a few minutes after a possible exposure (as would occur with exposure to nerve agents, vesicants, or corrosives), it is possible that the threat has been a hoax or that personal decontamination may not be of benefit. Many experts suggest personal decontamination if the probability of a true exposure is high, as several infectious agents such as anthrax and smallpox can be transmitted via clothing and direct contact. When no disease has been noted but the probability of exposure is high, a reasonable approach includes showering exposed individuals and placing clothing in biohazard bags pending investigation. Removal of underclothing is not necessary.

Antidotes, antibiotics, vaccines, and other pharmaceuticals have a key role in treatment and prophylaxis after chemical-biological events. Although the National Disaster Medical System has designated local sites for stockpiling these agents, in many areas there continues to be an inadequate supply.[1,33] Additionally, the agents are often stockpiled in distant centers (eg, the CDC). Moreover, proper doses of many vaccines and antidotes have not been established for children. For many vaccines such as anthrax, efficacy in children is unstudied. Finally, preferred antibiotic therapies (eg, tetracycline) generally are not used in children.

Other community resources to involve include local health departments and poison control centers. Poison control centers should be used as resources and central clearinghouses for toxicologic information that is to be given to the public and health care personnel.[16,18] Information including antidotes and

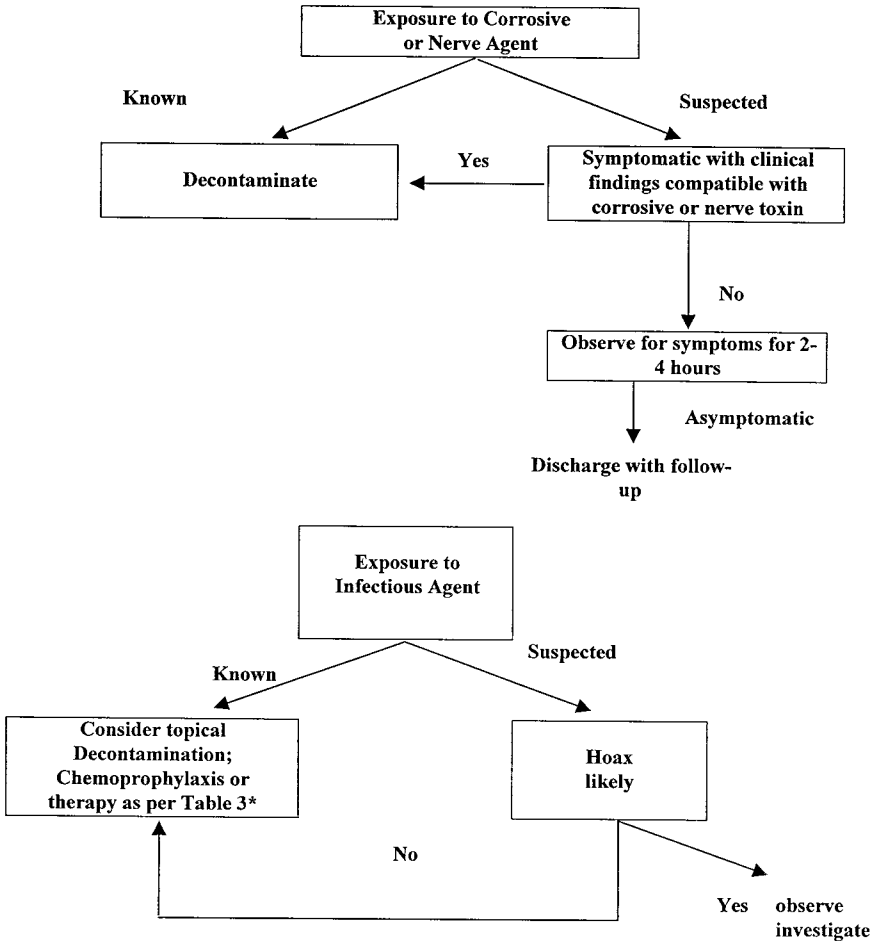

Fig 1. Determination of whether to perform topical decontamination on exposure to a chemical or biological agent.

decontamination strategies may be rapidly distributed by poison centers to hospitals, police, and the public.[16]

Proper preparation for a chemical-biological incident also involves care after the event, including the establishment of teams to evaluate the environment for reinhabitation, for mental health assessment of victims, and long-term epidemiologic assessment.[3] Pediatricians have an essential role in responding to psychosocial sequelae of a chemical-biological incident.[38–40] Critical incident stress management programs are useful in averting crisis-induced psychological disturbances among health care professionals.[2,17,36,41,42]

RECOMMENDATIONS FOR PEDIATRICIANS

1. Pediatricians should participate in community efforts to establish response plans for a chemical-biological incident, which may include work with local schools and child care facilities.
2. Pediatricians should assist in developing protocols for offices and local health care facilities, including the creation of a disaster system, procurement of protective gear, and creation of separate ventilation/decontamination areas.
3. Pediatricians have a key role in identifying sentinel cases of illness after a chemical-biological release. The index of suspicion should rise after the appearance of unexplained illness clusters. If a mass exposure is suspected, the local and state health departments should be contacted.
4. Pediatricians should assist in the development of local critical incident stress management programs for children to manage the psychological effects of a chemical-biological disaster.
5. Pediatricians (through continuing education) and pediatric trainees (through residency) should be educated in issues of pediatric disaster management, including the medical response to chemical-biological events.

RECOMMENDATIONS TO GOVERNMENT

1. Federal, state, and local agencies must continue to develop coordinated plans for meeting the consequences of a chemical-biological event. These plans should include specific protocols for management of pediatric casualties. Pediatricians should be included in planning at every organizational level (eg, the Departments of Defense and

Justice, Federal Emergency Management Agency, and state/local emergency medical services).
2. To ensure proper triage, disaster teams should include pediatricians and other personnel skilled at evaluating and treating children in the decision-making—particularly when young, preverbal children are involved.
3. Pediatric health care facilities (eg, children's hospitals, pediatric emergency departments, and pediatricians' offices) should be included in all aspects of preparation since they are likely to become primary sites for managing child casualties. Financial support should be given to create specialized areas such as isolation zones and decontamination rooms.
4. Government agencies should work to ensure that adequate supplies of antibiotics, antidotes, and vaccines are available to children, that they are efficacious, and that pediatric doses are established. Resource allocation plans should ensure that these agents are readily available to pediatric health care sites.
5. Support should be provided for research into behavioral consequences of the chemical-biological threat on children.[2]

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