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Committee on Environmental Health and Committee on Infectious Diseases

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American Academy of Pediatrics
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POLICY STATEMENT

Chemical-Biological Terrorism and Its Impact on Children

Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of All Children

Committee on Environmental Health and Committee on Infectious Diseases

ABSTRACT

Children remain potential victims of chemical or biological terrorism. In recent years, children have even been specific targets of terrorist acts. Consequently, it is necessary to address the needs that children would face after a terrorist incident. A broad range of public health initiatives have occurred since September 11, 2001. Although the needs of children have been addressed in many of them, in many cases, these initiatives have been inadequate in ensuring the protection of children. In addition, public health and health care system preparedness for terrorism has been broadened to the so-called all-hazards approach, in which response plans for terrorism are blended with plans for a public health or health care system response to unintentional disasters (eg, natural events such as earthquakes or pandemic flu or manmade catastrophes such as a hazardous-materials spill). In response to new principles and programs that have appeared over the last 5 years, this policy statement provides an update of the 2000 policy statement. The roles of both the pediatrician and public health agencies continue to be emphasized; only a coordinated effort by pediatricians and public health can ensure that the needs of children, including emergency protocols in schools or child care centers, decontamination protocols, and mental health interventions, will be successful.

INTRODUCTION

In April 2000, the American Academy of Pediatrics (AAP) Committee on Environmental Health and Committee on Infectious Diseases published the technical report "Chemical-Biological Terrorism and Its Impact on Children."[1] Events until that time, including the 1995 sarin attack in Tokyo, Japan, had made clear the possibility that acts of domestic terrorism can occur, with significant impact on the health of children. Since publication of the 2000 technical report, many additional acts of chemical and biological terrorism have occurred, including the release of anthrax spores through the US postal system, intentional food contamination by toxic chemicals in Grand Rapids, Michigan, and Fresno, California, and the identification of ricin-laden letters in a post office in South Carolina.

Immediately after the September 11, 2001, terrorist attacks in the United States, which soon were followed by anthrax releases, the AAP, recognizing the need to address the impact of terrorism on children, initiated a series of unprecedented actions. These actions included (1) formation of the AAP Task Force on Terrorism, (2) creation of a comprehensive Web site on the AAP home page devoted to providing information on terrorism and its impact on children (www.aap.org/terrorism/index.html), (3) publication of the technical report "Radiation Disasters and Children,"[2] (4) publication of a policy statement on smallpox immunization,[3]

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Key Words
chemical terrorism, biological terrorism, emergency preparedness

Abbreviations
AAP—American Academy of Pediatrics
PPE—personal protective equipment
CDC—Centers for Disease Control and Prevention
SNS—Strategic National Stockpile
CHC—community health center
DMAT—disaster medical assistance team
CISD—critical incident stress debriefing

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(5) an addition to the *Red Book* of descriptions of biological weapons and management of the diseases they produce,[4] (6) publication of a technical report[5] and policy statement[6] on the pediatrician and disaster preparedness, and (7) publication of the CD-ROM *Feelings Need Checkups Too*, designed to address mental health consequences of terrorism in children (www.aap.org/profed/childrencheckup.htm).

The continuing occurrence of chemical and biological terrorism makes clear the ongoing need to improve public health and health care system preparedness in all respects, including the detection of covert events, establishment of comprehensive response protocols for children, and implementation of plans for rapid resource mobilization. At the governmental level, these actions have been facilitated by the passage of key federal legislation (Table 1).[7] However, there remains a need for pediatricians to be knowledgeable about the chemical and biological weapons that could be used against a population that includes children. Moreover, many new principles in the care of children after chemical and biological terrorism have been developed. This policy statement replaces the 2000 policy statement, with an added focus on systems issues that are key in minimizing morbidity and mortality to children after their exposure to a chemical or biological weapon.

AGENTS OF CONCERN

Chemicals

In recent years, there have been 3 significant changes in the traditional concepts of terrorism involving chemical weapons. First, the narrow belief that such weapons would be intentionally manufactured to be instruments of mass destruction has been expanded by the recognition that readily available chemicals (eg, chlorine) manufactured for another purpose can be used for chemical terrorism (so-called weapons of opportunity). Second, the general impression that chemical terrorist events are likely to be dramatic and immediately recognized, such as the sarin incident in Tokyo, has been expanded to include the possibility that these acts can be covert, with delayed recognition. Finally, the concept that single individuals, acting impulsively and having few to no resources, can successfully release a chemical weapon must be considered in addition to the concept that chemical weapons are likely to be released by well-organized and funded terrorist groups after extensive planning.

Two recent acts of chemical terrorism involving children illustrate these new concepts. In 1999 in Fresno, California, patrons of a restaurant developed severe gastroenteritis. An investigation by public health authorities ultimately found that the carbamate insecticide methomyl had been maliciously added to the salt.[8] More than 100 adults and children became ill with nausea, vomiting, and diarrhea; a perpetrator was never identified. In 2002 in Grand Rapids, Michigan, a disgruntled grocery worker placed a nicotine-containing insecticide into ground beef, making it available for purchase by unsuspecting customers. It was not until widespread illness (nausea, mouth burning, vomiting) was reported and there was a recall and analysis of the meat, revealing the presence of nicotine, that this was recognized as an act of terrorism.[9] Ultimately, more than 100 people became ill, including more than 40 children, in what is now considered the largest act of chemical terrorism in US history.

The chemicals considered the most likely threat for use as chemical weapons are placed into 6 categories: nerve agents, vesicants, irritants/corrosives, choking agents, cyanogens, and incapacitators, including lacrimators (Table 2).

Nerve Agents

Nerve agents are well absorbed through intact skin and even through examination gloves used in clinical settings. All nerve agents act as acetylcholinesterase inhibitors, producing the same signs and symptoms associated with organophosphate poisoning. Manifestations can range from mild (miosis, nausea, diarrhea) to severe (muscle weakness, fasciculations, respiratory failure, coma, seizures).

In the 1995 sarin episode in Tokyo, the most unanticipated sequela was the degree of injury to health care professionals.[10] Several hundred physicians, nurses, and other health care professionals became ill as a result of 2 factors: handling of sarin-contaminated victims without wearing personal protective equipment (PPE) and the entry of contaminated victims into health care facilities, leading to transmission of sarin vapor through the ventilation system.[10,11] This event firmly demonstrated the importance of protecting health care professionals through the use of PPE and the importance of maintaining office or hospital safety by ensuring that victims are adequately decontaminated before entering the building.

TABLE 1 **Federal Legislation Enacted Since 2001 to Improve Public Health Response to Bioterrorism and Other Public Health Emergencies**

Date	Legislation
June 2002	Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (H.R. 3448)
November 2002	Homeland Security Act (H.R. 5005)
April 2003	Smallpox Emergency Personnel Protection Act (H.R. 1770)
April 2003	Emergency Preparedness and Response Act of 2003 (S. 930)
July 2003	Community Protection and Response Act of 2003 (H.R. 2878)
July 2003	Enhanced-911 Implementation Act of 2003 (H.R. 2898)
July 2004	Project Bioshield Act of 2004 (S. 1504)
2003	Robert T. Stafford Disaster Relief and Emergency Assistance Act (Pub L No. 106-390)
2003	First Responders Partnership Grant Act of 2003 (S. 466)

TABLE 2 **Chemical Weapons of Concern**

Agent Classification	Built Weapon	Weapon of Opportunity
Nerve agents	Tabun	Pesticides
	Sarin	Nicotine
	Soman	Organophosphates
	VX gas	Carbamates
Vesicants	Lewisite	
	Mustard gas	
	Nitrogen mustard	
Irritants/corrosives		Ammonia
		Bromine
		Chlorine
Choking agents	Phosgene	Perfluoroisobutylene (Teflon) and other chemical polymers
	Nitrogen oxides	Smoke, products of combustion
Cyanogens ("blood agents")	Hydrogen cyanide	Industrial cyanide
		Sodium azide
		Carbon monoxide
Incapacitators	3-Quinuclidinyl benzilate (BZ)	Anticholinergics
	Cannabinoids	
	Barbiturates	
	Fentanyl derivatives	
Lacrimators	Chloroacetophenone (CN)	Capsaicin
	Chlorobenzylidene (CS)	

Management of nerve-agent exposure includes supportive care and, when indicated, prompt administration of the antidotes atropine and pralidoxime.[12] Both of these antidotes are available in autoinjector form, permitting rapid administration; autoinjectors are particularly important in mass-casualty incidents where there is a need to treat large numbers of victims as quickly and efficiently as possible. Until recently, the rapid administration of atropine and pralidoxime to children was complicated by the absence of pediatric autoinjectors; only the forms approved for adults, containing 2 mg of atropine and 600 mg of pralidoxime, were available. A pediatric atropine autoinjector was recently approved by the Food and Drug Administration for use in small children after nerve-agent exposure.[13] However, the continued absence of a pediatric pralidoxime autoinjector, which is key in the successful treatment of central nervous system and muscular toxicity from nerve agents, leaves the use of standard, multidose vials as the only therapeutic option. To address this issue, consensus guidelines now recommend that children weighing 13 kg or more (2–3 years or older) receive a 600-mg dose of pralidoxime from an autoinjector, on the basis of the belief that this pralidoxime dose falls within the range of safety for the drug.[5] Children weighing less than 13 kg should receive the customary weight-based (20–50 mg/kg) dose, administered from a multidose vial; if unavailable, an autoinjector should be used.

Other aspects of care to children who have been exposed to nerve agents are found in recent reviews.[12,14]

Vesicants

Vesicants include sulfur mustard and lewisite, an arsenic-based blistering agent. These chemicals, both of which are released as an aerosol, produce erythema, burning, vesiculation, and then desquamation of the skin. Victims of vesicant exposure typically develop skin tingling followed by burning; within 24 hours, skin sloughing begins to occur, with wounds having the appearance of partial-thickness burns. These agents are also immunosuppressive, further increasing the risk of severe infection. Treatment is largely supportive. Important principles of management include protection of health care professionals through the use of PPE and topical decontamination.[15] Because vesicants are often oil based, a mild soap or shampoo should be used during decontamination.

Choking Agents

Choking agents are created to produce, usually in delayed fashion, pulmonary injury with resulting bronchospasm, pulmonary edema, and respiratory failure. Immediate symptoms include eye burning, tearing, and blepharospasm. The major agent of this group is phosgene; however, common industrial chemicals, including polytef (Teflon) and other chemical polymers, act as choking agents depending on their ambient concentration. Most choking agents are heavier than air, which could result in higher concentrations at the breathing level of the child. Treatment is supportive.

Cyanogens

The cyanogens are similar to cyanide in structure and/or function. Agents in this class include cyanide salts and sodium azide. The cyanogens interrupt cellular utilization of oxygen, producing respiratory distress, coma, and metabolic acidosis. Victims of cyanogen exposure must be recognized promptly to administer the life-saving antidotes sodium nitrite and sodium thiosulfate.

Incapacitating Agents

Incapacitating agents include several different chemical classes (eg, anticholinergic agents, hallucinogens, cannabinoids, and fentanyl derivatives). In the Russian theater hostage incident in 2002, what is thought to have been a fentanyl-based incapacitating agent was released during the rescue effort. The agent, although successful in overwhelming the hostage-takers, also killed 127 hostages.[16]

Many incapacitating agents are weapons of opportunity, being easily acquired pharmaceutical agents or substances of abuse that are surreptitiously added to common sources of food or drink.

Included among incapacitators are lacrimators. Often referred to collectively as Mace or "tear gas," lacrimators include the chemicals chloroacetophenone and chlorobenzylidene as well as capsaicin ("pepper spray"). Lacrimators are designed to produce incapacitation from irritation of the eye and other mucous membranes. Exposure to Mace results in eye burning, tearing, and blepharospasm; victims may become temporarily blind. Inhalation produces mouth pain, shortness of breath, and, in rare cases, laryngospasm. Because capsaicin is widely sold as a nonlethal weapon, episodes of capsaicin release into the ventilation system of schools and buildings are a relatively common prank, although such incidents meet the definition of terrorism (ie, an act designed to frighten, hurt, or kill).

Biological Agents

Most of the biological agents that could be used as weapons are now discussed in the *Red Book*,[4] although some agents (eg, ricin) are not discussed in detail. Ricin is discussed in a subsequent section of this report.

The biological weapons of concern are listed in Table 3. These agents have been placed by the Centers for Disease Control and Prevention (CDC) into categories A, B, or C. Thirty-nine agents are included in these 3 categories.

Category A agents are considered the greatest public health threat because of their high morbidity and mortality, potential ease of dissemination, and potential to cause public panic. Currently, there are 6 agents in this group: anthrax, plague, smallpox, botulinum, tularemia, and the viral hemorrhagic fevers, including Ebola and Marburg viruses. Detailed descriptions of these agents have been published in *Red Book*[4] and elsewhere.

TABLE 3 **Biological Weapons of Concern**

Category A
Anthrax (*Bacillus anthracis*)
Smallpox (*Variola major*)
Tularemia (*Francisella tularensis*)
Plague (*Yersinia pestis*)
Viral hemorrhagic fevers (filoviruses [eg, Ebola, Marburg] and arenaviruses [eg, Lassa])
Botulinum (*Clostridium botulinum* toxin)
Category B
Q fever (*Coxiella burnetii*)
Brucellosis (*Brucella* species)
Glanders (*Burkholderia mallei*)
Melioidosis (*Burkholderia pseudomallei*)
Viral encephalitis (alphaviruses [VEE, EEE, WEE])
Typhus (*Rickettsia prowazekii*)
Biotoxins (ricin, staphylococcal enterotoxin B)
Psittacosis (*Chlamydia psittaci*)
Food-safety threats (eg, *Salmonella* species, *Escherichia coli* O157:H7)
Water-safety threats (eg, *Vibrio cholerae*, *Cryptosporidium parvum*)
Category C
Emerging threat agents (eg, Nipah virus, hantavirus)
Multidrug-resistant tuberculosis
Tick-borne encephalitis viruses
Tick-borne hemorrhagic fever viruses
Yellow fever

VEE indicates Venezuelan equine encephalomyelitis; EEE, eastern equine encephalomyelitis; WEE, western equine encephalomyelitis.

Smallpox

The most widely discussed category A agent in recent years has been smallpox. In 2001, because of increasing concerns that smallpox was in the hands of terrorists and had the potential to produce widespread morbidity and mortality, the CDC recommended a "ring immunization" (surveillance and containment) strategy in the United States. This strategy of containment was reviewed and endorsed by the AAP Committee on Infectious Diseases in its 2002 policy statement "Smallpox Vaccine."[3] Subsequently, the CDC recommended a 3-phase plan for smallpox immunization of health care professionals and other individuals.[3] During the first phase, health care professionals in acute care facilities were to be immunized. In the second phase, there would be potential expansion to other health care professionals and first responders. In a possible third phase, voluntary immunization would be available to all those interested in being immunized. This campaign, to date, has struggled from several difficulties, including (1) the inability to quantitate the risk of a smallpox release, preventing individuals from making their own risk/benefit analysis, (2) an extensive list of contraindications to the vaccine, (3) general fears about the safety of the vaccine, (4) the appearance of unrecognized adverse effects from the vaccine (eg, fatal cardiac disease[17,18]), (5) lack of endorsement by several medical organizations,[19] and (6) a high rate of vaccine refusal by health care professionals.[20] Currently, the immunization campaign remains underway, still in phase I. Review and updating of the recommendations are ongoing.[21,22]

Ricin

Although it is a category B agent, ricin has become a major biological weapon of concern. A plant-derived, heat-stable toxin, ricin is an extract of the castor bean (*Ricinus communis*). Ricin acts by first entering cells through endocytosis; once in the cell, it is transported to the Golgi apparatus and endoplasmic reticulum. In the cytosol, ricin acts as a protease-resistant, enzymatically active structure that interacts with the sarcin-ricin domain of the large ribosome subunit RNA. This interaction can disturb translation by preventing the binding of elongation factors to the ribosome. Ricin is also capable of inactivating nonribosomal nucleic acid substrates.[23–26] With these effects, ricin produces severe morbidity and mortality. Rapidly dividing tissues, particularly the gastrointestinal epithelium, are most susceptible to ricin actions.

Ricin is a versatile agent that can be administered by ingestion, inhalation, or injection. When ingested, it can produce a syndrome of severe gastrointestinal upset, vomiting, hemorrhagic gastroenteritis, shock, and cardiovascular collapse. After inhalation, respiratory distress with a necrotizing pneumonitis may occur. Injection produces rapid shock and cardiovascular collapse. Treatment is supportive. A vaccine against ricin is currently under development.

Over the last 2 years, ricin has been associated with terrorist activity in the United States on multiple occasions. In October 2003, 2 ricin-containing letters were found in the US postal system.[27] In a third incident, ricin was found in the mail sorter of a congressional post office in January 2004. There have also been multiple confiscations of ricin in the United States and abroad over the last 5 years.

EXPOSURE VECTORS FOR CHEMICAL AND BIOLOGICAL WEAPONS

Exposure to chemical and biological weapons can occur through several potential vectors. Airborne releases of agents have remained the primary concern, because very large populations can be exposed by this route. Potential mechanisms of exposure include crop-dusting airplanes, tainted letters, and release into confined spaces (eg, subway tunnels, office buildings, theaters). Although contamination of the water supply is also a potential vector for exposure, there are very few chemical or biological agents that are both water-stable and resistant to water-purification techniques.[28] Finally, the contamination of food that is either unprocessed (eg, uncultivated grain) or processed (eg, a consumer product) is considered a potential means of exposure to chemical or biological weapons.[29]

SPECIFIC VULNERABILITIES IN CHILDREN

After events of chemical or biological terrorism, children have a greater risk of both exposure and harm, the result of key developmental and physiologic vulnerabilities.

For each of the vectors of exposure to biological or chemical weapons (air, water, or food), children possess a significantly greater likelihood of exposure because of their intake patterns. Children inhale considerably more air on a per-weight basis than adults (400 vs 140 mL/kg per minute, respectively). Consequently, for any concentration of airborne toxin, a child will inhale more of the substance on a per-weight basis than an adult. Also, substances that are heavier than air have their highest concentration near the ground, closer to the breathing zone of the child. Because children have less-keratinized, more-permeable skin and/or a proportionately greater body-surface area, they have both greater exposure and a greater likelihood of systemic toxicity to agents that fall on their skin.[30] Children have fluid and food intakes that differ significantly from adults. For example, children ingest approximately 100 mL/kg per day of water, compared with the 40 to 60 mL/kg per day that adults ingest. Children drink more milk than adults, placing them at risk of exposure to agents that can enter the milk supply through contamination of the grass on which cows feed; in the Chernobyl radiation disaster, cows grazed in contaminated pastures, resulting in excess radioactivity in their milk. Children drinking this milk sustained significant exposure to radioisotopes, including iodine and strontium. Finally, children not only eat more food on a per-kilogram basis but also have diets that are distinctly different from adults (eg, greater consumption of fruits).

Once exposed to a chemical or biological agent, children have numerous physiologic vulnerabilities that could lead to a greater risk of harm.[1] These vulnerabilities include undeveloped self-preservation skills that make them less able to flee danger; an immature immune system that makes them less able to contain infection (eg, plague)[31]; less fluid reserve, which can result in a greater risk of severe dehydration after exposure to agents that produce excess gastrointestinal fluid loss; and a greater risk of anxiety reactions and posttraumatic stress disorder after witnessing or being victim to a terrorist act.[32–34]

PUBLIC HEALTH PREPAREDNESS

The All-Hazards Approach

Over the last 5 years, a massive public health effort to improve response capability to future acts of biological terrorism has appeared. Such efforts have included antibiotic stockpiling, resurrection of smallpox immunization, and an unprecedented level of added support to state and local public health departments. Similarly, to respond to a possible chemical attack, extensive resources have been provided to public health authorities and first responders (fire, police, and emergency medical services) to create systems that will provide effective mitigation efforts. The initiation of these response campaigns revealed large-scale weaknesses in state and local public health infrastructure. Moreover, it became evident that intense effort was being directed toward events that might never occur rather than public health threats of much greater likelihood (eg, the appearance of an emerging infection or an unintentional hazardous chemical release).[35] Finally, it became clear that a fragmented and reactive public health–response plan is more expensive and inefficient than a single, comprehensive plan. As a result, disaster-response agencies and public health authorities have increasingly embraced the concept of the "all-hazards approach." Representing a dramatic paradigm shift in the preparation for chemical and biological terrorism, the all-hazards approach is designed to augment public health infrastructure, using an integrated model of disaster response.

Creation of all-hazards response systems has led to significant enhancements in public health–response capabilities. For example, the same protocol created to respond to the appearance of smallpox can be easily modified to contain an outbreak of severe acute respiratory syndrome (SARS). Similarly, an effective public health–response protocol for a sarin release would be equally effective for a hazardous-materials ("HAZMAT") release in the community.

Syndromic Surveillance

Overt acts of chemical and biological terrorism such as the sarin release in Tokyo present the challenge of rapidly identifying the agent and mobilizing the proper interventions. However, acts of chemical and biological terrorism may also be covert. Examples include the release of anthrax in 2001 and contamination of ground beef with nicotine in 2002. Covert incidents pose a significantly greater public health challenge and are more likely to induce widespread fear than overt events. Mechanisms for early recognition of a covert chemical or biological event, therefore, are necessary to contain the incident and minimize its impact.

Syndromic surveillance, a specialized type of outbreak detection, is a term used to describe mechanisms for monitoring health indices or events that reflect the early stages of an infection or disease of public health importance in an effort to minimize consequences.[36,37] Syndromic surveillance is considered an important means of identifying public health emergencies in their initial stages. Syndromic surveillance techniques can be clinician based or automated. Many syndromic surveillance systems are emergency department based. In addition, most state and local health departments are pursuing automatic electronic laboratory disease reporting.

The traditional mechanism of syndromic surveillance has been the clinician who recognizes unusual patterns of disease and reports them to public health authorities. The "astute clinician" principle places all health care professionals (including physicians, nurses, emergency medical technicians, epidemiologists, and health educators) in the role of sentinels for the appearance of disease clusters or other clinical abnormalities. The pivotal role of physicians and other health care professionals in syndromic surveillance, particularly for acts of terrorism, has led the CDC and other agencies to educate clinicians about chemical and biological weapons release and the diseases they produce. Clinical cues, case definitions, and syndromes for chemical weapons exposure have been published (Table 4), along with numerous resources to expand clinicians' ability to recognize covert terrorist incidents.[37,38]

Over the last few years, there has also been a rapid increase in the development of real-time, automated syndromic surveillance tools. A rapidly proliferating area, such automated decision support uses software to identify sentinel events such as an unusual amount of work or school absenteeism, changes in consumer purchase of over-the-counter products (eg, cough syrups or antipyretics), and changes in the chief-complaint profile among those who visit primary care physicians or emergency departments.[39–41] For example, the CDC has de-

TABLE 4 **Clinical Syndromes Associated With Chemical and Biologic Agents**

Category	Clinical Syndrome	Potential Etiologies
Cellular hypoxia	Altered mental status, dyspnea, seizures, metabolic acidosis	Cyanide, carbon monoxide, hydrogen sulfide, sodium azide
Cholinergic crisis	Salivation, diarrhea, lacrimation, bronchorrhea, diaphoresis, miosis, fasciculation, weakness, bradycardia, altered mental status, seizures	Nicotine, nerve agents, organophosphates
Gastrointestinal illness	Abdominal pain, vomiting, profuse diarrhea, hypotension, cardiovascular collapse	Ricin, staphylococcal enterotoxin E, arsenic
Lacrimation	Tearing, blepharospasm, incapacitation	Lacrimators ("Mace"), ammonia, halogens (chlorine, bromine)
Mucosal irritation	Tearing, nose and mouth burning, sore throat	Ammonia, halogens
Muscle rigidity	Generalized muscle contractions, painful neck/limb spasm, seizure-like activity	Strychnine
Muscle weakness	Generalized muscle weakness, ptosis, respiratory embarrassment	Botulism
Peripheral neuropathy	Muscle weakness or atrophy, "stocking-glove" sensory loss, depressed or absent deep tendon reflexes	Arsenic, thallium
Respiratory distress, acute onset	Cough, wheeze, shortness of breath, generalized mucosal irritation	Ammonia, halogens
Respiratory distress, delayed	Cough, respiratory distress, wheeze, hypoxia, pulmonary edema	Phosgene, sulfur mustard

veloped the Early Aberration Reporting System as a software tool available to clinicians and health departments around the nation (www.bt.cdc.gov/surveillance/ears).

New Governmental Roles in Emergency Preparedness

Although emergency-preparedness legislation existed before 2001, passage of additional rules between 2002 and 2005 resulted in massive efforts by the federal government to improve public health readiness across the nation (Table 1). Over the last 4 years, appropriations from federal to state public health agencies have been substantial. The Department of Homeland Security was established as a new member of the federal cabinet. Several departments within the Department of Health and Human Services have undergone extensive change, such as the CDC, Food and Drug Administration, and National Institutes of Health, all of which have reorganized their practice, regulatory, and research priorities to include chemical and biological terrorism, along with other public health threats; in 2002, the CDC established the Office of Terrorism Preparedness and Emergency Response. At state and local levels, planning for chemical and biological terrorism is now coordinated by multiple agencies, including departments of health, emergency-management agencies, poison control centers,[42] and law enforcement authorities.

The Strategic National Stockpile (SNS) has become one of the most important initiatives in mass-casualty disaster response.[5] Designed to respond to disasters that overwhelm local resources, the SNS includes such capabilities as the delivery of medications and supplies to areas of need within 12 hours of the request. SNS supplies include a pediatric formulary and materials for compounding tablets and capsules into liquid formulations (www.bt.cdc.gov/stockpile/index.asp).

SYSTEMS ISSUES IN PREPAREDNESS FOR CHEMICAL AND BIOLOGICAL TERRORISM

School and Child Care Center Preparedness

Children spend most of their waking hours in school or child care centers, away from their parents and guardians. Despite the fact that the majority of most children's day is spent in the care of the school system, efforts to create a blueprint that assists schools in developing comprehensive disaster-response protocols have been weak. School districts remain highly variable in the extent of their preparation for public health emergencies of any type, including chemical and biological terrorism.

Ideally, every school should produce its own response protocols rather than following a one-size-fits-all disaster plan that fails to take into account the school's physical plant, student size and characteristics, the presence of children with special needs, school nurse availability, and proximity to certain areas such as industries, rail yards, or highways.[40] All schools, in conjunction with local public health officials, should develop comprehensive evacuation and sheltering-in plans. Because local school bus fleets can typically evacuate only a fraction of children at one time, a means of mobilizing additional transport vehicles should be developed. General outlines for the development of a school emergency-response plan are found in Table 5.

Hospital Preparedness

Hospital protocols for pediatric victims of chemical or biological terrorism must be established in both pediatric and nonpediatric hospitals. These disaster protocols require an integrated response from the emergency department, ICU, operating rooms, and other key clinical areas within the hospital. Response needs include an adequate number of pediatric supplies, and a staff trained in the care of ill children will be needed to minimize morbidity and mortality.[5,6] All hospitals should have disaster protocols for pediatric patients, including mobilization of child life specialists, volunteers, and others who can provide comfort and distraction to children, particularly if those children are not yet united with their parents.

To be fully prepared for chemical or biological terrorism, pediatric and general hospitals must also have an evacuation plan should the hospital environment become uninhabitable. Although protocols for "vertical evacuation" (ie, the removal of patients to other floors within the same building) are well established in hospital-based disaster response, comprehensive plans for complete building evacuation are less well developed. Pediatric hospitals requiring full evacuation may have the additional challenge of transporting pediatric pa-

TABLE 5 Key Aspects of School Response to Chemical-Biological Terrorism and Other Public Health Emergencies

Assembly of the school crisis-response team
Principal, counselors, nurses, custodians
Contact and coordination with local public health–response team(s)
Evacuation[52]
Plan includes plans for rapid evacuation of physically and developmentally disabled children from all floors
Plan includes strategy for evacuation/relocation in inclement weather
Relocation
Plan includes the transport of medications, contact telephone numbers, and other essential material
Plan informs parents in advance of relocation site
Sheltering-in[53]
Designed for response to outdoor threats
Lockdown
Designed for response to a threat within the school
Communication with parents
Anticipates inability of parents to reach the school by telephone
Potentially includes automatic callout system, voice mail, parent contact "tree," or Web-based communication system
Policy for use of cellular phones by students during a disaster
Protocols for disaster response by after-school programs, including athletics

tients to health care facilities with relatively few pediatric resources. Nonetheless, memoranda of agreement with nearby or affiliated institutions are a key part of a comprehensive pediatric hospital disaster plan.

After exposure to a chemical or biological weapon, children may become covered by toxic material that can produce skin injury or be absorbed, producing systemic toxicity. In the case of infectious material, the contamination of skin could be sufficient to represent a threat to health care professionals as well as the victim. When children are covered with unknown but potentially dangerous chemical or infectious material, immediate decontamination is required.[43] Topical decontamination has 2 distinct components: disrobing and showering. To minimize exposure to health care professionals and patients within the health care facility, the child should be disrobed outdoors, before entering the ambulance or building. Disrobing alone accounts for more than 85% of topical decontamination and is an extremely effective means of ending exposure. When possible, the victim should disrobe himself or herself to minimize exposure to others. Health care professionals should not assist in disrobing unless they are wearing appropriate PPE.

Showering complements disrobing by further removing chemicals, microbes, and debris. As with disrobing, showering must occur outdoors; protocols should include strategies for preventing hypothermia in children. Principles of showering include the establishment of 3 management zones in the decontamination staging area (so-called hot, warm, and cold in reference to the site's degree of contamination), use of water that has been warmed to a temperature of 100°F, a water pressure of 60 psi, and, if possible, containment of the wastewater. If the toxic material is oily or firmly adherent to the child's skin, soap or a mild shampoo should be used; solutions such as mild bleach should not be used on children because of the risk of skin injury.[5] If an outdoor shower is not available, the child can be simply disrobed before being brought into the health care facility for care. Decontamination can be a frightening procedure for children, exacerbated by the identity-concealing PPE that clinicians are wearing. Efforts should be made to keep parents nearby; when possible, parents should be used to assist with their child's decontamination.

All health care professionals who assist in decontamination must protect themselves by wearing appropriate PPE. Currently, there are 4 levels of PPE, ranging from level A, which is the highest level of protection, to level D, which consists of simple gown, gloves, and surgical mask. For hospital personnel, level C PPE (a chemical-resistant suit and gloves, with an air-purifying respirator) is considered adequate for hospital-based management of most contaminated victims. Health care facilities should develop plans for rapid access to such equipment. Staff should be appropriately trained. Other principles of decontamination and PPE are outlined in Table 6 and have been published recently.[44,45]

Community Health Center Preparedness

Community health centers (CHCs) and local health departments are, in most major metropolitan areas, an important source of "safety-net" health care and social support to a community. In a large-scale terrorist disaster, CHCs could play a pivotal role in supporting the community and nearby hospitals. First, in the event of an infectious outbreak, families will likely go to their CHC for treatment and to obtain information from professionals whom they trust and who are more likely to provide culturally competent care. In addition, after a multiple-casualty incident, hospitals may become too crowded to treat every patient. In such cases, CHCs could potentially be used as alternate care sites, providing care to those with minor injury and assisting in interventions (eg, mass administration of antimicrobial agents). CHCs, therefore, should be included in planning by local public health authorities.[5]

Office Preparedness

The pediatrician should have an important role in the community response to any disaster involving children. First, the pediatrician's office may be the preferred site of care for many victims who are transporting themselves for treatment. Both chemically contaminated children and children with suspected illness from a biological weapon might go directly to the pediatrician's office. Consequently, pediatricians should consider the development of office protocols for disasters, including (1) management of a child who requires decontamination, (2) management of a child with a potentially transmis-

TABLE 6 Principles of Decontamination

All decontamination should occur outside the health care facility.
All health care professionals should wear appropriate PPE, as determined by their safety officer and occupational health specialist.
All levels of health care professionals should be trained to use PPE, including physicians, nurses, clinical assistants, security, and environmental services.
Remove clothing from the victims as quickly as possible. Victims should disrobe themselves when possible.
Discarded clothing should be placed in labeled plastic bag and stored for possible use by law enforcement.
Shower water should have a temperature of approximately 100° F and a pressure of 60 psi.
Water alone is used routinely. If material is oily, a mild soap or shampoo can be added.
Victims should shower for 5 minutes unless specific alternative recommendations are given.
If possible, water effluent should be contained rather than placing it in the local wastewater stream.
Use heat lamps, blankets, and other mechanisms to prevent hypothermia.
Critically ill victims should simply be disrobed and not showered before entering the health care facility. Cover hands, feet, and other exposed areas if there is evidence of gross contamination.
If there are multiple victims, anticipate the need to perform out-of-hospital triage.

sible infection, and (3) management of a sudden influx of pediatric patients after a large-scale incident.[5] The AAP textbook *Childhood Emergencies in the Office, Hospital, and Community*[46] is a useful resource to assist in office planning for such emergencies. Pediatricians should also consult their state and local health departments, because most have electronic health alert networks.

Surge Capacity

An effective response to large-scale chemical or biological terrorism (ie, an incident with more casualties than routine operations can accommodate) requires the creation of surge-capacity protocols. Federal, state, and local public health authorities are essential in assisting health facilities during crises of large magnitude. Nonetheless, both pediatric and nonpediatric hospitals should consider how a large-scale event would affect their facility. Plans for such an event might include (1) the creation of additional bed spaces through cohorting, (2) mechanisms for the rapid discharge of inpatients to increase capacity, (3) an inventory of all sites in the hospital where critical care can be provided, (4) establishment of a site, ideally out of the hospital, for patient triage, (5) identification of care sites for those whose injuries are minor, (6) mechanisms for labeling and tracking patients, particularly children who arrive without personal identification, and (7) plans for maintaining hospital security by preventing the entry of contaminated victims and other unauthorized individuals. For nonpediatric hospitals, surge-capacity plans for a mass-casualty chemical or biological incident involving children should also include mechanisms for mobilizing health care professionals with pediatric expertise. Surge-capacity principles are summarized in Table 7. Disaster medical assistance teams (DMATs), supported by the US Public Health Service, have been created by the National Disaster Medical System to provide assistance to regions after a large-scale disaster. However, among the 27 DMATs in the United States, only 2 are dedicated pediatric DMATs, significantly limiting the federal response capability to a pediatric mass-casualty incident. The Metropolitan Medical Response System, another federal effort designed to create regional "medical strike teams," has no clearly established pediatric capability or standards.

TABLE 7 Surge-Capacity Principles for Hospitals

Preparation
Obtain PPE, showers, and other emergency-response equipment
Stockpile supplies
Stockpile or plan for additional pharmaceuticals
Perform drills; consider tabletop exercise
Response
Anticipate a 1:5:7 ratio of critically ill/urgently ill ("walking wounded")/well ("worried well") casualties
Anticipate the "second-wave" phenomenon
Reserve the emergency department for critically ill patients
Perform triage and decontamination outside the hospital
Ensure campus security from unauthorized intrusion
Identify and utilize alternate sites of care; identify transportation options

Mental Health

The mental health consequences of terrorism are extensive and, in many cases, enduring. Children have a disproportionate risk of developing emotional and behavioral sequelae; investigations after the September 11th attacks found that as many as 25% of children developed acute anxiety followed by posttraumatic stress disorder.[33,47,48] Children can develop a broad range of behavioral problems after a disaster, whether they witness the incident or simply observe their parents' response to an incident (eg, from a television broadcast). Overt manifestations may include emotional lability, insomnia, frequent crying, depression, fear, and "anniversary grief." Alternatively, mental health consequences may also be subtle and elusive (eg, manifesting as multiple somatic complaints).

Parents may similarly become psychological casualties after chemical or biological terrorism. Visual replay of events on television may contribute to the development of long-term behavioral disturbances. As with children, the parent may have overt or subtle signs of distress. Adults typically display loss of appetite, insomnia, depression, hopelessness, and acute anxiety.

Finally, health care professionals who care for victims of chemical or biological terrorism can develop mental health consequences. There is an extensive body of literature indicating that health care professionals can become extremely depressed, developing posttraumatic stress disorder after caring for victims. To reduce the risk of this occupational hazard, the concept of critical incident stress debriefing (CISD) was created many years ago. In principle, a prompt debriefing session can be therapeutic by permitting staff to verbalize their feelings and anxieties about what they have experienced. CISD has become a common part of postevent disaster management. Recently, however, questions about the efficacy of CISD in reducing mental health sequelae among health care professionals have been raised.[49] There are increasing concerns that the process of debriefing forces health care professionals to relive events, undoing internal resolution that is already underway. In addition, the process of group debriefing may carry the risk of having health care professionals hear about disturbing events that they themselves did not witness, creating anxiety and depression that was not present initially. Although this issue remains controversial, there is consensus that efforts should be made to identify health care professionals who are suffering psychological sequelae from their involvement in responding to an act of chemical or biological terrorism.

Individual/Family Preparedness

Large-scale disasters, whether they are natural (eg, hurricanes or floods), unintentional (eg, hazardous-materials release), or intentional (ie, terrorist), can occur at any time. All families, particularly families with children, should have a disaster plan. Such plans should include communication in the event of cellular phone failure, a reunification plan if disaster occurs when family members are not together, and emergency provisions in the home. Multiple resources are available to assist families in home disaster planning (www.ready.gov/index.html and www.fema.gov/plan/index.shtm).

RECOMMENDATIONS TO PEDIATRICIANS

1. Because the threat of chemical or biological terrorism continues and children are likely to be affected disproportionately by such acts, pediatricians should be knowledgeable about agents of concern and their management and the response systems that are needed to minimize physical and mental trauma to children. Following the principle of the all-hazards approach, pediatricians should become and remain knowledgeable about principles of preparation and response to similar public health emergencies (eg, hazardous-materials incidents or emerging infections).
2. Pediatricians should participate, as need and opportunity arises, in local public health activities in chemical and biological terrorism preparedness. The pediatrician can be a valuable resource to public health authorities in issues such as first-responder training and hospital preparedness. In addition, involvement of pediatricians in these activities increases the likelihood that the needs and vulnerabilities of children will be considered.
3. Pediatricians should work, where possible, with local school systems to develop plans for rapid evacuation, relocation, triage, and initial care of children who are in school when an act of chemical or biological terrorism occurs.
4. Because pediatric victims of chemical or biological terrorism may present to their pediatrician's office, there should be consideration of plans and protocols for management of such children on site. Such preparation may include the establishment of out-of-building decontamination protocols and isolation of potentially infectious patients from others.
5. Pediatricians should be prepared to assist families in disaster planning by providing education on key principles such as basic emergency equipment in the homes, including flashlights, alternative heating, lighting, and a supply of water, food, and clothing. Discussion about how to talk to children about war and terrorism should be included.[50]
6. Pediatricians should evaluate and ensure proper treatment for children for mental health sequelae after chemical-biological terrorism, particularly because these sequelae can develop days to months after the event.[51] The AAP Web site offers multiple resources for pediatricians and families (www.aap.org/terrorism/index.html, www.aap.org/profed/childrencheckup.htm, www.aap.org/advocacy/releases/disastercomm.htm, and www.aap.org/terrorism/topics/psychosocial_aspects.html).

RECOMMENDATIONS TO GOVERNMENT

1. The needs of children should be addressed in all preparedness efforts at the federal, state, regional, and local levels.
2. All recommendations made by the National Advisory Committee on Children and Terrorism (www.bt.cdc.gov/children/recommend.asp), designed to ensure that children are included in emergency-response planning, should be implemented.
3. Public health agencies should make a concerted effort to assist schools and school districts in their preparedness efforts. Emergency-response plans for schools should be tailored to the individual school and its location, population, staff, and resources.
4. DMATs created by the National Disaster Medical System will play a key role in a mass-casualty incident involving children. The pediatric training of these teams should be comprehensive. Creation of additional pediatric DMATs should be considered.
5. Public health agencies should continue to actively provide assistance and resources to hospitals, pediatric offices, CHCs, and other health care facilities to ensure that they are prepared to respond to a chemical or biological terrorist incident that involves children.
6. As funding for emergency preparedness continues, the needs of children should always be included among the deliverables and performance benchmarks.

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