



Chemical-Biological Terrorism and Its Impact on Children

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Chemical and biological events (including infectious disease outbreaks) may affect children disproportionately, and the threat of a chemical or biological attack remains in the United States and worldwide. Although federal programs and funding support a broad range of federal initiatives for public health preparedness and response, funding at the state and local levels has been flat or is decreasing, potentially leaving communities vulnerable. Consequently, pediatricians need to prepare and be ready to care for children in their communities before, during, and after a chemical or biological event, including during long-term recovery. Some medical countermeasures for particular chemical and biological agents have not been adequately studied or approved for children. The American Academy of Pediatrics provides resources and education on disaster preparedness and response, including information on the pediatrician's role in disasters, pediatric medical countermeasures, and mental health after an event as well as individual and family preparedness. This policy statement addresses the steps that clinicians and policy makers can take to protect children and mitigate the effects of a chemical or biological attack.

INTRODUCTION

Children remain victims of chemical or biological terrorism; recent examples include the 2017–2018 chemical attacks by the Assad regime against civilians in Syria. Emerging biological outbreaks, such as the global 2013–2016 Ebola outbreaks originating in West Africa and the 2016–2018 Zika virus outbreak, offered opportunities to test response systems that would be needed in the case of biological terrorism. Consequently, pediatric health care providers, in collaboration with public health officials and emergency management personnel, must be prepared to respond to the needs of children before, during, and after a chemical or biological event. Pediatric health care providers can help by offering guidance to the local, state, and federal governmental and nongovernmental organizations that are charged with caring for children,

abstract

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Dr Chung provided substantial contributions to the conception and design of the work, contributed to drafting and revising it critically for important intellectual content, gives final approval of the version to be published, and agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; Drs Baum and Nyquist provided substantial contributions to the conception and design of the work and contributed to drafting and revising it critically for important intellectual content; and all authors approved the final manuscript as submitted.

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

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and they can be a valuable resource for first-responder training as well as community and hospital preparedness, response, and recovery. Involvement of pediatric health care providers in preparedness planning and training activities increases the likelihood that the needs of children will be considered and addressed.

STATEMENT OF THE PROBLEM

Pediatricians play a pivotal role in providing care in the medical home and supporting the community before, during, and after a chemical or biological event. To this end, pediatricians and their staff can proactively seek education and be prepared to promote and share information on readiness approaches, offer anticipatory guidance to families, report appearances of unusual disease clusters, and help guide families after events. The intent of this policy statement is to provide pediatricians and other professionals with an overview of the following:

1. children's vulnerabilities with respect to chemical and biological events;
2. chemical and biological agents of concern; and
3. roles of the pediatrician in the medical home and in collaboration with prehospital and hospital organizations and governmental agencies in preparation for, detection of, and response to chemical and biological events.

NEW INFORMATION

This revised policy statement and a new, accompanying technical report replace the 2006 policy statement "Chemical-Biological Terrorism and Its Impact on Children."²

REVIEW OF EVIDENCE

Children's Vulnerabilities

Exposure to chemical and biological weapons may occur through a variety

of routes, including airborne, waterborne, or foodborne routes. Compared with adults, children have greater risks of both exposure and harm because of key developmental, anatomic, and physiologic vulnerabilities. These risks include the following differences between children and adults: children inhale considerably more air on a per-kilogram basis; they breathe air from a breathing zone that is closer to the ground, where heavier-than-air substances concentrate; they have a proportionately greater body-surface area, which is important when it comes to agents that contact the skin; and they ingest considerably more fluid (particularly milk, which may be contaminated with chemicals, especially radioisotopes, or biological agents) and food on a per-kilogram basis.

Children are among those most at risk for psychological trauma and behavioral difficulties after chemical and biological terrorism. Children may suffer from a range of short- and long-term effects on their psychological functioning, emotional adjustment, and developmental trajectory. Persistent adjustment reactions can be anticipated in some children long after a chemical or biological event, particularly among those who have escaped countries where such attacks may have occurred, or even in children without direct exposure to these events. There may be a need for specific disaster plans in schools for these students. The American Academy of Pediatrics (AAP) offers recommendations for pediatricians and others to work with families to develop plans within its Family Readiness Kit¹ and the policy "Emergency Information Forms and Emergency Preparedness for Children With Special Health Care Needs."²

Agents of Concern

For the purposes of this policy statement, agents of concern (chemicals and biological agents that can be used in

a terrorist attack) can be subdivided as follows: chemicals include nerve agents, blistering agents (vesicants), irritants (corrosives), choking agents, asphyxiants (cyanogens and carbon monoxide), and disabling (incapacitating) agents; biological agents include Centers for Disease Control and Prevention Category A agents (anthrax, botulism, plague, smallpox, tularemia, and the viral hemorrhagic fevers), which are considered the greatest public health threat. More details regarding these agents are in the accompanying technical report, "Chemical-Biological Terrorism and Its Impact on Children."³

Roles of the Pediatrician and Other Health Care Professionals

Comprehensive resources regarding presentation and management of illnesses due to chemical and biological agents are now accessible in different formats, such as apps or Web sites optimized for mobile devices, and have been developed to allow for just-in-time use in a disaster. The AAP continues to develop resources, including the accompanying technical report, to help all health care professionals to understand the needs of children in a disaster and provide specific guidance for chemical and biological threats. Additional information is provided in the AAP resource "Pediatric Disaster Preparedness and Response Topical Collection" (www.aap.org/disasters/manual).⁴

Pediatricians and other primary care providers are uniquely positioned to advance disaster preparedness and response: in their ability to care directly for patients, they can provide wisdom "from the field," coordinating with disaster response and public health authorities to guide rational preparedness and response efforts at local (including child care programs and schools), state, and federal levels. Because they understand the different developmental stages of children, pediatric health care providers can provide input on

planning for pediatric evacuation, triage, surge, and family reunification after disasters. In addition, pediatric health care providers may be the first to recognize and diagnose psychological trauma and behavioral difficulties after an event.

In recent years, these authorities have shifted their efforts to an “all-hazards approach,” which establishes a single integrated model of disaster response that can be equally effective for chemical and biological agents. In a disaster, health care providers must be ready to provide care outside of their usual scope of practice. In addition, health care providers may be the first to encounter or report an outbreak. Recent pediatric research has demonstrated that educational efforts increase health care professionals’ knowledge and confidence, which may improve their participation during an actual event.^{5,6}

Syndromic surveillance (detection of health indicators that precede diagnosis) potentially signals early stages of a chemical release or an infectious disease outbreak and may serve to minimize consequences. Reports of unusual presentations from pediatricians and other clinicians are critical, but additional methods may inform rapid epidemic detection.⁷ These methods include data gathered from automated monitoring of hospital emergency department diagnoses or individual Internet searches to crowd sourcing of social media applications on mobile devices. The latter technique was used after the 2017 sarin attacks in Syria, when researchers reviewed videos uploaded by civilians who documented clinical symptoms and gaps in clinical care.⁸

Prehospital and Hospital Organizations

Care of pediatric patients is becoming more regionalized, and definitive pediatric hospital care is becoming less available in the community.⁹ Although recommendations to improve pediatric readiness in

hospital emergency departments are available,¹⁰ pediatric interhospital transfers are increasing, and more definitive pediatric hospital care is becoming gradually dependent on referral centers.⁷ In addition, given that in 2013 only 46.8% of US hospitals reported having a disaster plan that included pediatric considerations, the care of children during a local chemical or biological attack can be impeded or delayed, which may lead to poor outcomes.¹¹ Recent ventilator research, for example, shows that there are few types of devices that are capable of supporting the ventilation of children of all ages.¹²

Hospital preparedness for patients with highly contagious infectious diseases has improved since the 2013–2016 Ebola outbreaks in West Africa. Federal agencies have established a regional treatment network for Ebola and other special pathogens, increasing the capacity to care for such patients, particularly children.¹³ Because of this experience, protocols for donning and doffing personal protective equipment have improved to better protect the safety of health care professionals.

Hospital readiness plans are most often developed to accommodate surge capacity, or increased numbers of pediatric patients. These may include, for example, the ability to create additional bed spaces through cohorting or rapid discharge of inpatients. Hospital policies need to recognize the developmental and psychological needs of children, especially those with special health care needs, and the importance of using age-appropriate equipment and supplies.^{14,15} Hospitals will want to prepare in advance to be able to track children who arrive without identification or parents or guardians and have plans for immediate family reunification.¹⁶ Exercises and drills are an important part of preparedness, and resources are

available to address pediatric preparedness and promote pediatrician involvement.^{4,17,18}

Personal Protective Equipment and Decontamination

After exposure to a chemical or biological weapon, children may become covered by toxic material that can be absorbed, ingested, or inhaled and produce systemic toxicity. Although chemical exposures may cause immediate symptoms, infectious exposures may have an incubation period. Regardless, if an exposure is known, victims will need to undergo immediate decontamination to remove the contaminant and prevent additional sequelae.¹⁹ To prepare for decontamination events, involved health care professionals need to be trained to don personal protective equipment to prevent secondary exposures. The decontamination process for victims includes removal of clothing followed by dry decontamination (absorbent or adsorbent materials) or wet decontamination (cleansed with soap and water or showers). For pediatric victims, the shower water should be warmed to avoid hypothermia and used at lower pressure to prevent additional skin damage. In cold climates, heat lamps, blankets, and other mechanisms may be needed to prevent hypothermia. Additional principles of decontamination are covered in the accompanying technical report.³

Poison Control Centers

In the event of a terrorist attack, the national network of state and regional poison control centers (1-800-222-1222) may be the first point of contact for health care providers and members of the public. These poison centers, staffed by certified specialists in poison information and backed by medical toxicologists, can triage disaster calls to appropriate local, state, and federal agencies.

Governmental Agencies

After the September 11, 2001, terrorist attacks and subsequent anthrax releases, the federal government expanded its emergency preparedness efforts. These include the establishment of the Department of Homeland Security in 2002 and, within the Department of Health and Human Services (DHHS), the Office of the Assistant Secretary for Preparedness and Response, in 2006. Other Department of Homeland Security and DHHS agencies, including the Federal Emergency Management Agency, the Centers for Disease Control and Prevention, the Food and Drug Administration, and the National Institutes of Health, have been reorganized to accommodate chemical and biological preparedness and response.

Although there have been some advances in pediatric medical countermeasures (MCMs), significant gaps remain.²⁰ The US Strategic National Stockpile, a part of DHHS, is the largest supply of potentially life-saving pharmaceuticals and medical supplies and is designed to support citizens in response to disasters that overwhelm state and local resources. As of 2013, only 40% of the medications in the Strategic National Stockpile have been approved for use in the pediatric population.²¹ There continue to be ongoing efforts at the federal level to ensure pediatric treatments for all chemical and biological threats. For medications that are not approved for pediatric patients, the Food and Drug Administration can issue an emergency use authorization or investigational new drug application for their use. If the medication falls under the investigational new drug application, additional consent would be needed, which could be challenging to explain to frightened parents and could present challenges to MCM mass-distribution efforts during a public health emergency. In addition, the absence of dedicated

pediatric autoinjectors for medications such as atropine hampers the ability of first responders to provide immediate care to younger children. Ongoing research and development is needed to ensure that all MCMs can be used safely in children, with attention being paid to appropriate dosing, formulations, and devices (eg, autoinjectors).⁵

SUMMARY AND RECOMMENDATIONS

The AAP provides supplemental details on many of the topics discussed in this policy in the accompanying technical report, "Chemical-Biological Terrorism and Its Impact on Children."³ This technical report contains more specific details on the role of the pediatric provider, specific hospital and health care needs, decontamination processes, and mental health implications related to chemical and bioterrorism events. Because the threat of chemical and biological terrorism continues, and children are likely to be affected by such acts, the AAP offers recommendations for pediatricians and others.

Recommendations for Pediatricians

1. Pediatricians should be aware of agents of concern as well as the response systems (eg, poison control centers and local and state agencies) that evaluate and manage children and strive to minimize their physical and mental trauma.
2. Pediatricians should become, and remain, aware of principles of preparation and response to similar public health emergencies (eg, hazardous-materials incidents or emerging infectious diseases). Education on the all-hazards approach should occur as early in training as possible as well as in continuing education. Telemedicine and telementoring (for example, Extension for

Community Healthcare Outcomes) with subject matter experts are potential solutions for just-in-time training).

3. Pediatricians need to be aware of pediatric decontamination strategies and appropriate use of personal protective equipment to protect health care staff.²²
4. Pediatricians should participate, as need and opportunity arise, in local public health and community exercises, drills, and activities (such as with first responders, at hospitals, and in the medical home) in chemical and biological terrorism preparedness, response, and recovery.⁵
5. Pediatricians should work, when possible, with local early care and education (ie, Head Start, child care, early childhood, and/or preschool) programs and school systems to develop plans for rapid evacuation, relocation, family reunification, triage, and treatment protocols (including vaccination) if an act of chemical or biological terrorism occurs. Pediatricians also should work with local school systems, child care centers, or child-serving agencies as well as mental health providers to help support children after such an event with age-appropriate and developmentally appropriate interventions.
6. Pediatricians should recognize their role in syndromic surveillance and detection of health indicators and familiarize themselves with the related medical sequelae and potential behavioral and mental health effects because children who were exposed to chemical or biological agents during a terrorist attack may present to their pediatrician's office for follow-up and long-term care. Many more children beyond those who were exposed directly will experience significant distress, and pediatricians will need to recognize signs and symptoms of

distress and proactively encourage these children and their families to receive support for their emotional and behavioral needs.

Recommendations for the Health Care Sector

1. Response to chemical and biological attacks will start locally. First responders and local public health officials should be prepared and ready to care for acutely ill and injured children of all ages. Preparation efforts should have adequate resources to provide appropriate MCMs, facility-transfer protocols, and pediatric training for staff (especially appropriate use of personal and protective equipment and decontamination protocols).
2. In addition to medical care of victims of a chemical or biological attack, health care systems and hospitals will need to prepare for the unique needs of children and their families in all phases of readiness, response, and recovery.⁷ This includes, but is not limited to, disease surveillance, decontamination of children, identification and tracking of unaccompanied children, family reunification, administration of MCMs to families, and mental health screening and services. Health system readiness for the needs of children and families during and after a disaster should be built on day-to-day pediatric emergency preparedness guidance.¹⁰
3. The needs of children and youth with special health care needs, including those of children with chronic health conditions, as well as a variety of physical and developmental disabilities must be incorporated into disaster planning.
4. Disaster exercises and drills involving the whole health care community should be conducted and include pediatric victims.

Recommendations for Government

1. Public health and emergency management agencies should work actively with pediatric health care providers to continue to provide assistance and resources to hospitals, pediatric offices, local AAP chapters, community health centers, and other health care facilities to ensure that workers in these facilities are prepared to respond to chemical or biological terrorist incidents that involve children.
2. The needs of children should always be included among the required deliverables and performance benchmarks in funding programs for emergency preparedness, response, and recovery. Furthermore, it is critical for this funding to include the ability to conduct research and collect data during disasters on the impact of the disaster on children (such as chemical or biological exposures) to develop or evaluate innovative solutions.
3. The federal government must ensure, through funding, research, and study trials, that all vaccines and MCMs can be used in children, which would include but not be limited to pediatric-friendly forms of administration, such as rapidly dissolvable formulations or appropriately dosed autoinjectors.
4. State and federal governments should support both funding and accreditation of continuing education on the topic of chemical and biological terrorism and ensure that mechanisms to address the needs of children are included. Maintenance of Certification credits are an important vehicle for the ongoing education of health care providers. Collaboration with the AAP on education is important because the AAP can assist with implementing Maintenance of Certification, quality-improvement

projects, Extension for Community Healthcare Outcomes clinics and telementoring projects, and additional educational efforts.

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ABBREVIATIONS

AAP: American Academy of Pediatrics
DHHS: Department of Health and Human Services
MCM: medical countermeasure

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