Abstract:
The frequency of national and international disaster events, increased media attention, and regulatory changes have all contributed to an improved public awareness of the vital role hospitals play in a crisis. Although hospital disaster preparedness efforts have matured dramatically since the September 11th 2001 terrorist attacks, much work still remains to prepare all hospitals for potential pediatric victims. This article emphasizes key emergency response aspects of hospital preparedness for disasters involving children, in particular (1) hospital-based incident command, (2) strategies for operational continuity, (3) pediatric principles of surge capacity, (4) development of decontamination protocols, (5) infection control, (6) sheltering in place, and (7) evacuation strategies.

Keywords:
pediatric hospital preparedness; infection control; shelter in place; evacuation

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Pediatric Aspects of Hospital Preparedness

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As our nation continues to develop and enhance its disaster response capabilities, the recent economic downturn and fierce competition for federal dollars have hampered progress. This was one of the key conclusions reported in the most recent annual report from the Trust for America's Health (TAH) and the Robert Wood Johnson Foundation, *Ready or Not? 2008*.[1] Among the most vulnerable populations affected by this slowing of progress are children. As a group, children represent 22% to 30% of the total population; because of their unique characteristics (ie, psychological, developmental, physiological and anatomical), children demand special consideration when conducting disaster planning. In addition, the TAH report supports the claim that children have significantly higher mortality rates in disasters when compared with adults. The TAH concludes that response planning remains incomplete for critical preparedness areas such as surge capacity, rapid disease detection, and food safety.[2] Because of their unique vulnerabilities, children and their needs must be incorporated into all stages of disaster planning to improve the response chain.

Hospitals are not exempt from this process. Given that 90% of America's children seek emergency care at general hospitals,[3] all hospitals must include pediatric needs in their emergency preparedness plans. In this article, we will discuss central components of hospital-based emergency preparedness programs with emphasis on pediatric preparedness. In addition, we will identify unique challenges to providing emergency response to children. Key emergency response aspects of hospital preparedness for disasters involving children include (1) hospital-based

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1522-8401/$ - see front matter
Published by Elsevier Inc.

incident command, (2) strategies for operational continuity, (3) pediatric principles of surge capacity, (4) development of decontamination protocols, (5) infection control, (6) sheltering in place, and (7) evacuation strategies.

HOSPITAL INCIDENT COMMAND SYSTEMS

One of the cornerstones of any emergency preparedness effort is the establishment of an Incident Command System (ICS). These crisis management systems are invaluable because they create a platform upon which to build a customized response to any hazard. Advantages provided by the ICS include the benefit of a clear reporting structure (chain of command), the ability to maintain accountability and management of multiple responders (span of control), and the standardization of terms that facilitates multidisciplinary coordination and decreases confusion (common language).

Hospitals have been using ICS for many years with the latest version of this system, Hospital Incident Command System (HICS) released in October 2006. A significant advantage of HICS is its reflection of the medical mission and infrastructure of a typical hospital while incorporating the standard ICS structure, enabling a seamless interface with other ICS agencies involved in disaster response. It is essential that health care agencies adopting HICS take the necessary steps to customize the system to reflect their own institutional capabilities and complexity. The standard HICS system model is shown in Figure 1. Highlighted in the figure are roles that should include pediatric focus.

Crisis Management Training for Key Leadership Roles

Strategies used by Children's Hospital Boston to support HICS activations include (1) limiting the number of eligible incident commanders, (2) supporting the incident commander pool with specialized training, and (3) creating a confidential review forum where each HICS activation is reviewed. Keeping the pool of potential incident commanders small increases each member's exposure to command opportunities and facilitates more intensive training on advanced HICS strategies. In institutions that provide care for both adults and children having at least 1 of the members of this pool with pediatric expertise will help others understand the vulnerabilities and unique needs of children. Creating a confidential review forum allows for all HICS activations to be reviewed and critiqued. Modeled after Morbidity and Mortality rounds, this forum allows for open discussion of each event and after action recommendations and allows for all members to gain from the combined experiences. Additional data support for this forum can be achieved through an event-tracking process where frequency of activation, type, and duration of event are noted, analyzed, and reported.

Institutions that do not have an abundance of pediatric-trained staff should also consider building customized HICS roles that would be dedicated to addressing pediatric concerns for roles such as medical (inpatient and outpatient unit leaders) and mental health care, family support unit leader, supply, pharmacy, nutrition, and security. Specific pediatric responsibilities for these roles may include a pharmacist with pediatric experience that can compound adult tablets into size-appropriate oral solutions. Another example is having trained child life specialists in the mental health care unit to provide age-appropriate distraction to pediatric victims. A comprehensive list of pediatric-specific HICS roles and their responsibilities is shown in Table 1.

STRATEGIES FOR OPERATIONAL CONTINUITY

At the core of every hospital's mission is a desire to provide essential services to all who seek them. Disasters and unplanned disruptions threaten a hospital's ability to deliver on this mission. Strategies to enhance operational continuity and challenges are presented.

Emergency Staffing Strategies

When disasters occur, hospitals in the affected area often experience inadequate staffing. A large influx of patients seeking care can overwhelm the capacity of on-hand hospital staff. Concurrently, there will be immediate loss of some staff due to child care, eldercare, or pet care obligations with others unwilling to come to work.[4] Hospitals maintaining higher nurse-to-patient ratios are better positioned to surge with on-hand staff. Through the use of departmental emergency call back procedures, these same hospitals may also be

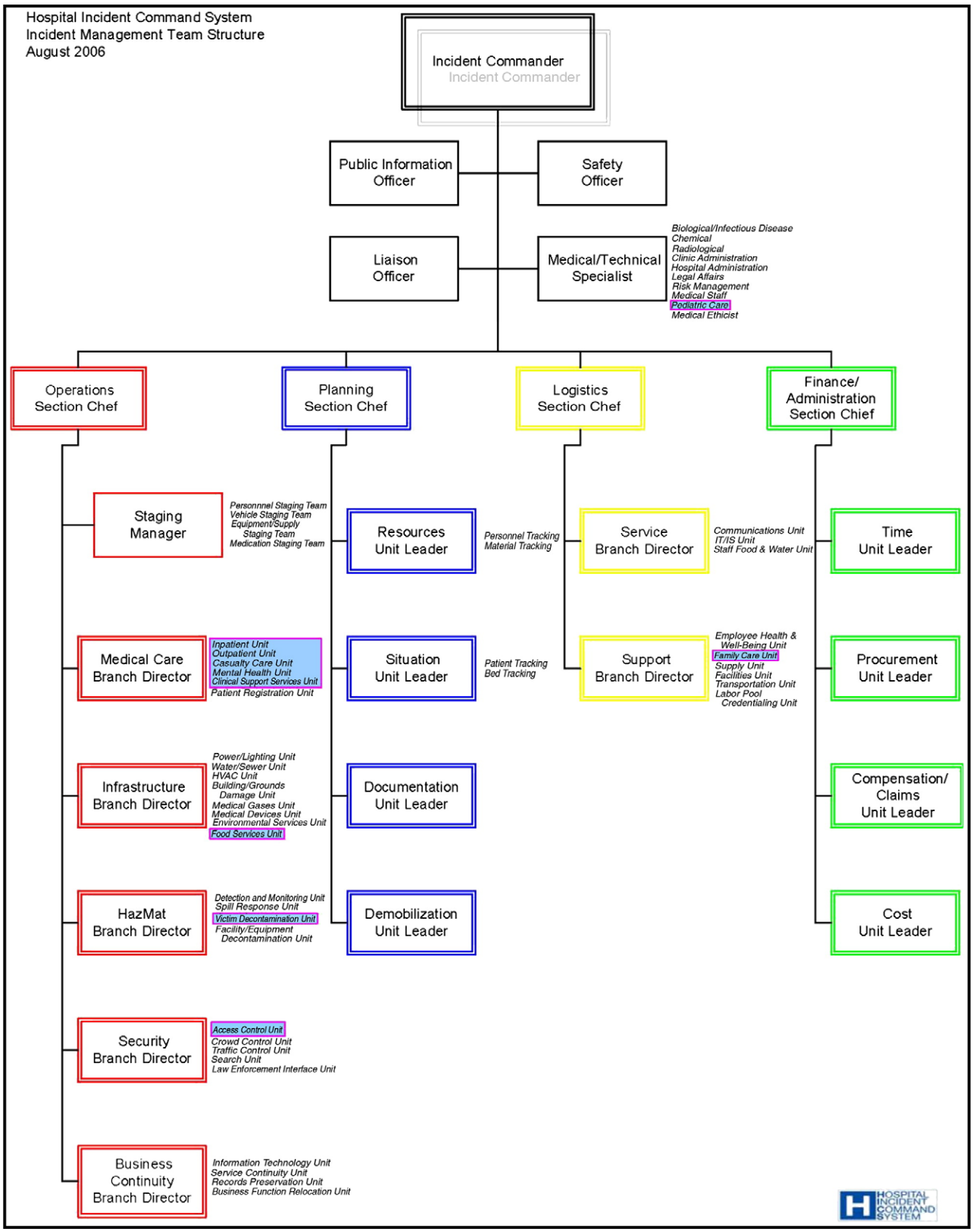

FIGURE 1. Sample HICS team chart with highlighted pediatric-specific roles. Standard Hospital Incident Command Team Chart. Available at http://www.emsa.ca.gov/HICS/files/color.pdf.

TABLE 1. Highlighted pediatric-specific roles.

HICS Position	Rationale for Pediatric-Specific Role
Medical technology specialist-pediatrician	Works within the incident command group to identify potential pediatric care related concerns and strategies
Family care unit	Helps coordinate issues of reunification and psychosocial issues of family (not victims)
Supply unit	Concerned with obtaining and distributing pediatric-specific equipment
Inpatient unit	Responsible for overall inpatient pediatric care (includes pediatric intensive care unit level care)
Outpatient unit	Responsible for overall outpatient pediatric care
Casualty care unit	Responsible for overall emergency department pediatric care
Mental health unit	Responsible for pediatric victim psychosocial and behavioral response
Food service unit	Responsible for nutritional needs of children
Victim decontamination unit	Responsible for providing age-appropriate communication and assistance while pediatric patients are undergoing decontamination
Access control unit	Responsible for security of pediatric patients (injured and well) and enforcing disaster credentialing identification/reunification policies as they relate to access control.

better positioned to surge their available pool of duty staff.

Another often-sited source for emergency volunteers is the Medical Reserve Corps (MRC). However, the number of pediatric-trained MRC volunteers is not known, and due to limited pediatric resources, those with pediatric knowledge may already be committed to their primary institution. A notable pediatric-specific issue is the lack of a required Criminal Offender Record Information or background check. For example, Children's Hospital Boston requires all employees and volunteers to complete Criminal Offender Record Information checks before being hired and credentialed. Applying these criteria to MRC's and other disaster volunteers may help to identify convicted sex offenders or other persons who should not have access to children during a disaster. Lastly, variable host hospital credentialing processes may force some MRC volunteers to be recredentialed to meet Joint Commission standards, causing potential delays.

Other challenges associated with disaster credentialing include registration, emergency credentialing, and verification. Several systems and methods exist to enable volunteer health care professionals to preregister in advance of a disaster with various medical response groups (eg, MRC, Red Cross, Community Emergency Response Teams, etc). However, standards for vetting information (eg, medical license source verification) vary from group to group. Often, volunteers are responsible for maintaining records of their credentialing and training. Therefore, it is possible that a health care worker who has recently been suspended by their licensing board may choose not to inform the medical response group.

Although neighboring facilities may have an abundance of licensed and available health care workers, without appropriate credentialing by the host site, these potential volunteers are prohibited from providing care. The creation and standardization of a hospital-based tool (ie, centralized database) housing privileged information on all the institution's licensed health care professionals have been proposed in the literature. One theoretical advantage is that linking such databases with a county health care agency or mutually acceptable organization will result in practitioners gaining disaster privileges faster and be able to assist impacted hospitals.[5]

Emergency Caches of Equipment

In the event that a disaster targets children, the use of predetermined pediatric disaster formularies will expedite disaster response. Formularies are a collection of prescribed items or supplies that can be requested through a single order number or code. Disaster formularies may include medical and pharmaceutical surge supplies and should augment the core pediatric equipment that may already be on-hand. Specific subformularies can be designed for specific hazards such as infectious outbreak, trauma, burns or hazardous material exposure, and contamination. Advantages of creating pediatric disaster formularies include the preidentification of essential equipment and pharmacological supplies, as well as a

TABLE 2. Pediatric-specific disaster surge formulary to support surge operations.[7]

Pediatric Formulary
Instruments/Equipment
Disposable BP cuffs—neonatal, infant, child, small adult
Artificial resuscitator bag masks—pediatric, infant
Patient personal care supplies
Bath basin
Cotton swabs
Facial tissues
Diapers
Pacifier
Belonging bag
Cotton balls
Respiratory system supplies
Nasal airways
Oral airways
Oxygen cannulas
Oxygen masks
ER/trauma/surgical supplies
Scalpel #11
Sutures (to be ordered individually by box)
General instrument tray
Facial suture tray
Chest drainage system
Buretol tubing, 60 drops
Thoracostomy tray
Chest tubes (8, 10, 12, 24, 32 Fr)
Thoracic catheter with tubing and container
Sterile towels
Sterile sheets
Small sterile basins
Electrodes
Monitoring electrodes
Dressings
Bandage scissors
2 × 2 dressings
4 × 4 dressings
Adhesive IV dressing
4 Bandage rolls
1 Paper tape
Adhesive bandages
Linen
Disposable sheets
Disposable pillows
Disposable pillow covers
Muscle/skeletal supplies
Limb restraints
Gastrointestinal system supplies
Antireflux valve (10, 12, 14 Fr)
Feeding tubes (5, 8 Fr)
Sharps: needle/syringes
Bulb syringes
Safety syringes (21, 25)
Filter needles
Catheter tip syringe 60 mL
Sharps container
Luer lock syringes, 20 and 60 mL
Syringes 1, 3, 5, 10 ml
IV access/supplies
IV start kits
Stopcock
T-connector
IV start catheter (18, 20, 22, 24 G)
Arm boards—infant, child
Blood administration tubing
IV filters (0.22 and 1.2 μm)
Syringe pump tubing
Microdrip tubing
IV solutions
Glucose water
Normal saline 10 mL
Normal saline 1000 mL
Irrigation solutions
Normal saline irrigation solution 2000 mL
Sterile water irrigation solution 2000 mL
Miscellaneous
Sterile lubricant
Alcohol wipes
Alcohol swab sticks
Tongue blades
Heel warmers
Tape measure
Body bag
Disposable linen savers
Safety pins
Povodine iodine wipes
Hydrogen peroxide
Individual bottled drinking water

BP indicates blood pressure; ER, emergency room; IV, intravenous.

cost-effective method of identifying disaster surge supplies without having to incur costs or maintenance challenges associated with storing these items on-site. Such pediatric disaster formularies must include equipment with varying sizes to accommodate children of all ages. Lists of basic pediatric equipment are widely available.[6] Examples of pediatric disaster formularies have been created by the Association for HealthCare Resources and Material Management and can be found at http://www.ahrmm.org/ahrmm/news_and_issues/issues_ and_initiatives/files/disaster_formularies.pdf. An example of such a formulary can be found in Table 2.

Emergency Notification Systems

The ability to communicate effectively is a top priority during a disaster. Emergencies and disaster response can place immediate stress on an organization, and it is essential that staff, external organizations, patients, and their families are all well informed.[8] Health care institutions have recently placed a high priority on mass notification systems to help maintain communications throughout an event. Advantages include the ability to organize intended receivers into groups (ie, staff by department or role, patients, and their families, etc), send messages in a variety of forms (voice and/or text) with different communication devices (mobile and landline phones, pagers, computers, etc), and administer these messages by providing tools that prioritize and confirm message path progress. These mass notification systems can be combined with other communication tools such as the Government Emergency Telecommunications System. Automated mass notification systems offer a number of advantages over traditional emergency call trees. However, they are potentially vulnerable to system disruptions, and therefore, the traditional maintenance of emergency call trees remains an essential planning strategy and should be exercised routinely.

In contrast to the information "push" strategies outlined above, another mass notification system is the utilization of customizable Web sites where responders and interested parties can "pull" necessary information. A well-designed event-specific Web site can be an extremely valuable and scalable method of communicating to a variety of different stakeholders. This is especially useful when the information is rapidly changing, and the only other alternative is to continue to barrage a wide distribution list with numerous "blasts" updates.

Alternate Care Sites

Alternate Care Sites (ACS) can be called upon when disasters strike and threaten to overwhelm the current health care infrastructure. They are typically buildings of opportunity that can be quickly converted for the purposes of providing care outside of typical health care infrastructure. Alternate Care Sites can be used in a variety of roles including a primary triage point, public distribution of medications or vaccines, or a low-acuity patient care site.[9] Pediatric planning for ACS must include caring for children without guardians as well as children with their families. Additional attention to childproofing ACS for safety, providing adequate staff to care for pediatric victims, and assigning security is needed to prevent possible harm to children.

Enabling the Response, Staff Safety

Among reasons for staff not being able to report to work during a disaster are transportation issues, childcare and eldercare responsibilities, personal health concerns, and pet care obligations. Historically, the reasons cited for not being willing to report include fear and concern for family and for self.[4] Including alternative transportation options like car pools or arrangements with local emergency management agencies may enable staff to respond to emergency requests. In addition, the importance of comprehensive staff support, for example, child/elder and pet care, and mental health support options must be addressed and communicated to staff in advance. Although staff response may still differ based on the nature of the catastrophe, generally staff awareness of the various forms of support services offered to staff will likely correlate with an increase in the number of employees who are able to respond. Lastly, the importance for each employee to create a personal preparedness plan should be supported by the institution. Without a personal preparedness plan, staff will have little alternative but to leave the response effort to tend to family-related needs.

In addition to providing the support services necessary to enable response, hospitals must also stockpile personal protective equipment. Stockpiles of N95 respirators, chemical decontamination or biohazard suits, and positive air-purifying respirators, and others, are critical to conveying to staff that their safety concerns have been adequately addressed. Also of paramount importance is the purchase and maintenance of pharmaceutical countermeasures and prophylactic agents for employees

and their families. Purchases of pharmacological agents may vary based on local community risks.

Lastly, hospitals must consider how they will further incentivize disaster response. Although Maryland and South Carolina have pursued legislation that obligate health care workers to respond to emergency requests for assistance or face a range of sanctions, this approach raises a number of ethical and legal concerns. An alternate strategy to increase disaster resources may include financial incentives, the use of volunteer networks, and protection from disaster-related liability.[10] For example, the California Disaster Service Worker Volunteer Program provides workers' compensation insurance coverage in the event a disaster service worker volunteer is injured while performing assigned disaster duties.[11] Hospitals that effectively create department-specific contingency plans and communicate comprehensive safety plans will ensure maintaining their operational continuity.

PEDIATRIC PRINCIPLES OF SURGE CAPACITY AND SURGE CAPABILITY

Before 2004, an established federal surge capacity planning guideline did not exist. Hospitals in rural and urban settings each crafted surge planning scenarios based on perceived risk and anticipated patient volumes. For example, Children's Hospital Boston established 2 different levels of surge response, the first dealing with 5 to 50 patients and the second dealing with more than 450 patients. In 2004, Health Resource and Services Administration set a critical benchmark for all States to establish a system that allows for the triage, treatment, and disposition of 500 adult and pediatric patients per 1 million population during a disaster.[12] One obvious advantage of moving to a population-based planning metric is that it is scalable. In addition, basing surge planning on population density facilitates a closer examination of the availability of pediatric specialty care resources within a local area.

Surge Capacity planning can be dissected into 2 planning categories: (1) surge capacity—defined as the ability to respond to a markedly increased number of patients, and (2) surge capability—defined as the ability to address unusual or very specialized medical needs.[13] By focusing on surge capabilities, specific pediatric planning aspects can be identified.

Children can be victims of a catastrophic event or direct targets of terrorism. After an event, children may be transported to a hospital for stabilization with limited pediatric resources. After large-scale disasters, most victims are not transported by ambulance; instead, they arrive at hospitals by their own means.[14] Therefore, reliance on prehospital responders to triage and transport children to specialized pediatric care hospitals will not mitigate the likelihood of all hospitals receiving injured children. Unfortunately, many emergency departments lack the basic equipment to adequately care for pediatric patients and remain unprepared for pediatric emergencies.[15]

Solutions and Recommendations for Pediatric Surge

The availability of pediatric equipment, trained medical staff, guidelines, and protocols for the care of injured children are essential to a successful response to catastrophic events. The American Academy of Pediatrics has created numerous tools to assist hospitals attempting to enhance their pediatric disaster response capability. Among them is a comprehensive guideline for pediatricians that can be found at http://www.aap.org/disasters/pdf/DisasterPrepPlanforPeds.pdf. In addition to the clinical guidance, there are numerous child care and school-based resources available at the American Academy of Pediatrics disaster Web site at http://www.aap.org/disasters/index.cfm.

Stockpiling critical supplies is another essential element of surge response. The potential for supply chain disruptions increases with the size and magnitude of the event. Therefore, hospital emergency management leaders must ensure adequate supplies by maintaining updated inventories on site and easy accessibility of supplies stored off site.

In planning for a surge of pediatric patients, it is essential to acquire and maintain plans for the following:

- pediatric equipment (ie, medical and nonmedical supply);
- pediatric-trained emergency and intensive care unit staff;
- psychosocial support (ie, pediatric social workers, child life specialists, psychiatry, and psychology);
- pharmacological inventories (both treatment and prophylaxis medications) and protocols for weight-based dosing and pediatric-appropriate preparations (*need reference here*); and
- security protocols—for specialized holding areas for injured and noninjured unaccompanied children.[16] Recommendations for the care and oversight of noninjured children

include at minimum security/supervisory ratios of:

1 adult to 4 infants;
1 adult to 10 preschool children; and
1 adult to 20 school-aged children.

There is a significant amount of literature that proposes several surge strategies. Most immediate activities involve clearing the emergency department of minor injuries and canceling elective procedures and admissions to conserve capacity.[17] Other emergency department surge strategies incorporated at Children's Hospital Boston include the division of the emergency department to disaster victims and nondisaster victims, separate entrances for each group, and establishment of unidirectional flow of patients. In addition, pediatric victims should be cohorted to minimize confusion and prevent the misplacement of these victims.

Infection Control Issues in Response to an Influx of Contagious Patients

The possibility of transmission of infectious agents and environmental contamination must be considered as part of surge planning. Hospitals must be prepared for the possibility of a large influx of infectious patients and must have plans in place to address infection control issues in that scenario. In Chapter 5 of the New York City Department of Health and Mental Hygiene Children in Disasters Tool Kit, the authors provide a comprehensive overview of infection control issues based on point-of-entry infection control measure, response to the asymptomatic exposed child, and a well-organized scenario-based series of response strategies.[18]

An event may involve as little as 1 patient infected with an epidemiologically significant pathogen (such as smallpox) or a large number of patients infected with a more common pathogen (such as influenza A). The precise response is contingent on the nature and magnitude of the event and the mode of transmission of the infecting organism. Regardless of the pathogen, a health care facility's resources may become stressed in regard to staffing, equipment, and supplies. Pediatric facilities may be disproportionately affected during infectious events, as many of the organisms with the potential to cause large outbreaks (including respiratory viruses such as influenza) are transmitted more easily among children as compared with adults because of frequent close contact with age-group peers and suboptimal hand hygiene and respiratory etiquette among young children.

Surveillance systems may indicate a potential infectious event in the early stages. A variety of surveillance activities from both internal and external sources are likely to be useful in this regard. Infection control departments at pediatric hospitals conduct routine surveillance to detect unusual infections or clusters of patients or staff with similar symptoms. In addition, emergency departments and public health authorities may perform real-time syndromic surveillance to identify clusters across a wider scale. These activities can facilitate a more timely response and initiation of the appropriate isolation precautions, which will minimize the risk of exposure and subsequent transmission of infection. Early response to a potential or actual influx of contagious patients should involve a collaborative effort between emergency services, hospital epidemiologists and infection control departments, pediatric infectious disease physicians, occupational health services, local and state public health authorities, and the incident commander for the facility.

One of the first steps in surge planning for infectious events is identifying a location for triaging or holding large numbers of patients that may present to a pediatric facility. Facilities should consider both outdoor locations (which may be helpful during an influx of patients with symptoms that may require airborne precautions) and indoor locations (for patients with symptoms requiring standard, contact, or droplet precautions). One important pediatric-specific aspect of this planning is consideration of the containment of young children who are ambulatory; safety is a prime concern in this setting (eg, if a parking lot or traffic circle is to be used during an influx, facilities must ensure that vehicles are not being driven through areas where large numbers of small children may be running freely).

Interventions to reduce the risk of exposure and transmission of infectious diseases among patients, families, and staff members will depend on the specific infecting organism and its mode of transmission. However, until a diagnosis is confirmed, there are several general precautions that can be taken to minimize these risks. For symptom complexes that suggest potential airborne or droplet transmission (such as fever with respiratory symptoms and/or rash), facilities should consider the following actions: (1) supply patients and family members with surgical masks (donning masks is not always feasible for young children, and families may require assistance in placing masks on their

children); (2) provide coverage (such as clean sheets or hospital gowns) for rashes or skin lesions that may be a source of transmission; (3) instruct patients and family members on cough etiquette and provide tissues, hand sanitizer, and red bag trash receptacles; (4) instruct patients and families to maintain at least 3 ft of spatial separation from other patients, if feasible; and (5) provide fitted respirators (eg, N95s) or powered air-purifying respirators, surgical masks, gowns, and/or gloves to employees caring for patients. In addition, for certain infections (such as viral hemorrhagic fevers), additional supplies may be required, including impermeable gowns, eye protection, and head and foot coverage. For symptom complexes that suggest potential contact transmission (such as vomiting and/or diarrhea), facilities should consider the following actions: (1) provide hand sanitizer and instruct patients, families, and staff members about the importance of careful hand hygiene; (2) provide emesis basins and instruct patients to use only dedicated bathrooms or portable toilet facilities; (3) provide gowns and gloves for employees caring for patients; and (4) emphasize proper cleaning and disinfection of the environment to reduce contamination.

Transporting patients with potentially contagious illnesses requires careful advance planning. Patients who are isolated should only leave the environment for essential medical purposes. If transporting a patient is necessary, isolation precautions must be maintained and appropriate supplies (such as surgical masks) must be supplied. Receiving departments must always be notified about the transport in advance so that appropriate precautions can be taken in the receiving location. Additional transport interventions, such as evacuation and securing of the transport route and elevators, may be required depending on the infecting organism.

Managing supplies is a critical component of surge planning for infectious events. Specific supplies that should be monitored include respirators (including both N95 and powered air-purifying respirators), surgical masks, gowns, gloves, eye protection (face shields or goggles), and hand hygiene agents (both alcohol-based hand sanitizers and soap). For pediatric events, consideration must be given to supplies of both pediatric- and adult-sized personal protective equipment such as masks. A dashboard showing each item, the number in stock, and the ideal par level can be updated daily and is helpful for planning purposes during such a scenario. When supplies are limited, facilities may consider alternative sources such as public health agencies or neighboring hospitals, which may be able to lend supplies if the event is not widespread.

TABLE 3. A comprehensive pediatric and adult medical countermeasure stockpile.

Atropine	DTPA bulk	
BAL in oil	Hydroxocobalamin	Pralidoxime
Calcium DTPA	Mark I kits	Prussian blue
Cidofovir	Mark I trainers	Pyridostigmine
	Midazolam	Rimantadine
Ciprofloxacin	Oseltamivir	
Cyanide antidote kits	Pediatric atropine	Zanamivir
Doxycycline	Potassium iodide	Zinc DTPA

DTPA indicates diethylenetriamine pentaacetic acid. BAL indicates dimercaprol injections USP.

In addition to personal protective equipment, infectious events may necessitate the use of medications (such as antibiotics or antivirals used for prophylaxis or treatment), vaccines, or other agents. A pharmacological stockpile can also help to allay fear and uncertainty among the workforce that can drive absenteeism, especially as it relates to potentially infectious agents.[4,19] Limited resources prohibit the purchase of all agents for all potential scenarios, and stockpiles should ideally reflect the perceived and known risks inherent to each institution and patient population. Having a memorandum of understanding in place across institutions in a region allows for pharmaceutical supplies to be easily transferred to those hospitals in need. An example of a comprehensive pediatric and adult pharmaceutical stockpile may be found in Table 3.

Developing tiers that separate health care workers in different levels of risk exposure can be a useful strategy. The type of health care worker and the quantity in each tier will differ depending on the infectious agent and the route of exposure. These tiers enable planning groups to more accurately anticipate the costs associated with purchasing and maintaining a workforce protection pharmacy stockpile. Hospitals that have committed funds to the purchase and maintenance of a workforce pharmacological stockpile must also develop plans for emergency distribution. “Closed” or nonpublic points of distribution plans should focus on the

logistics of priority distribution of medication to identified essential staff. These plans should include how to distribute the on-hand workforce stockpiles as well as the method for requesting and obtaining additional distributions from regional caches (eg, Center for Disease Control and Prevention chempaks) and national push-paks from the Strategic National Stockpile.

Finally, communication is a key component of managing an influx of contagious patients. Timely dissemination of information to staff members, patients and families, public health authorities, and the media can ensure that education about symptoms and instructions about patient management are rapidly and widely circulated. This communication can also alleviate anxiety among patients, family members, and staff. Information about case counts, modes of transmission, and infection control measures may change rapidly during an infectious event, and facilities should use a variety of strategies to update key stakeholders, including signs, electronic communication, and Web sites that can be used for rapid posting of real-time updates and that can serve as a centralized source of current information and guidance. Pediatric facilities should be prepared to act as vocal advocates for pediatric-specific issues (such as school closures or instructions for childcare programs) during collaborations with neighboring facilities and local and state public health agencies, which often focus on strategies that are tailored to adult patients and may forget about necessary modifications for children.

DECONTAMINATION

Given the number of victims that will bypass prehospital systems and come directly to the hospital, each hospital must have plans for decontamination. Building a successful decontamination program requires understanding placement and accessibility of equipment, staff training, and communication capabilities for both workers and victims.

There are a number of issues that arise in the development of pediatric-specific decontamination strategies. To effectively prepare for these pediatric-specific challenges, all decontamination programs should include having sufficient on-hand supply of age-appropriate equipment (eg, decontamination cubbies for infants), a communication program that prepares children for the decontamination experience through visual and verbal communication channels, warm water to prevent hypothermia, age-appropriate protocols that minimize psychosocial issues of privacy, and a method of assuring security and implementing tracking measures into all phases of the decontamination process.

SHELTERING IN PLACE

The importance of a substantial shelter in place capability is not only for the patients and families but also for the community. The former Joint Commission Vice President for Accreditation Field Operations, J. Cappiello recently identified hospitals as "critical to the survival and sustainability of the community during times of disaster…because hospitals may be the most fortified structure in the community".[20] Hospitals are able to use emergency generators for power and climate control and normally maintain stockpiles of food and medication. Buttressing this belief, 2008 standards by The Joint Commission explicitly require hospitals to adopt a "96-hour" stand-alone rule (Element of Performance: EM.02.01.01- 3), where each critical access hospital must carefully identify its "stand-alone" capability, should the community services and primary supply chains be disrupted or unavailable.

Important shelter-in-place strategies should include contingency planning for (1) food and water; (2) medical, nonmedical, and pharmacological supplies; (3) communication systems; (4) redundant and resilient infrastructure; and (5) information management procedures during "downtime."

Food stockpiling, both which items to store and how much, should be carefully considered because food preparation equipment may be adversely affected by the event. Also, items in the stockpile must meet the nutritional and developmental needs of all ages including formula for infants and table food for toddlers. Specific medical and nonmedical supplies were previously mentioned; however, where to store disaster supplies and issues of emergency access should be carefully considered. Telecommunication systems are jugular to any emergency response. Investing in redundant telecommunication systems decreases the likelihood of a complete failure. A strategy used at Children's Hospital Boston is to have 2 different telephone systems: traditional landline based and voice-over internet protocol telephone systems. Combined, these 2 systems greatly reduce the likelihood of a complete telecommunication failure. This redundant system strategy can be replicated for other mission critical systems such as potable water, electrical power, and reverse osmosis water filtration system (provided that your institution needs such a system to provide dialysis care). For hospitals that are migrating toward computer-

based documentation, considerations for alternate or "down-time" procedures must be created, should these electronic systems become inaccessible. Paper-based documentation forms and procedures should be well understood and easily accessible, even if the institution is committed to migrating to an online medical record.

By acknowledging the potential emotional and physical vulnerability of pediatric victims, planning efforts will consider the mental health and security implications of caring for children. Specifically, by providing (1) specific pediatric HICS roles (Family Care Unit Leader, Psychosocial Unit Leader, etc), (2) enhanced security, (3) pediatric and "safe" shelters, children are more protected throughout a shelter in place response. Family Care Unit leaders can assist families by providing updates and serving in reunification efforts for lost or missing children. Psychosocial responders (eg, psychologist, social workers, child life specialists) can also be useful in reducing fear and anxiety for pediatric victims. Enhanced security tracking systems can assist by limiting access to disaster victims. This is important because the number of on-hand security officers will likely not meet the demand caused by the disaster. Automated door access systems, surveillance cameras, and alarms all serve to help segregate and protect the vulnerable pediatric population while they are receiving care or awaiting reunification. Lastly, not all pediatric victims seeking shelter are medically injured. Plans for creating "safe" shelter conditions for uninjured children should also be developed. This is an area where hazards have been removed and age-appropriate toys and resources are available.

EVACUATION

Evacuation remains the final option for hospitals unable to function during and following a disaster. Over the last 5 years, numerous hospitals have been forced to partially or completely evacuate their patient population. Irrespective of the cause for evacuation, there are many risks associated with moving hospital patients. Preplanning for evacuation routes is essential. Identifying appropriate receiving facilities, security concerns, and family reunification all increase the complexity of evacuating children.

Universal recommendations for evacuation planning include mobilizing transportation resources in advance. This can be facilitated by creating a comprehensive evacuation memorandum of understanding with local and regional emergency services providers. One challenge of transferring pediatric patients is that there are limited numbers of pediatric facilities compared with adult tertiary care centers (pediatric to adult hospital ratio: 75:4000). By understanding the regional pediatric capabilities, standard "distance-from-facility" mapping of potential receiving facilities can be developed. This reference would summarize the type and resource care capability by pediatric specialty in a region and be depicted by distance from the evacuation site (ie, 50-, 100-, and 150^{+}-mile radius).

To ensure pediatric patients are transferred to the appropriate acute care facilities, a new evacuation concept is being tested at Children's Hospital Boston. This matrix uses a modified current inpatient acuity early-warning assessment tool[21] and cross references these scores to potential pediatric receiving facilities based on their capability. Although in draft form, this tool may enable staff to quickly assign potential evacuees to appropriate receiving facilities using data that is collected continuously in real time.

Other pediatric challenges for evacuation include lack of small child evacuation devices and the increased number of services and specialties that are necessary when attempting to provide age-appropriate care during an evacuation. For example, Sled-like evacuation devices are designed for adolescent and large children; however, they are not ideal for toddlers and infants. Depending on the age and the ability of the evacuee to understand the evacuation event, age-appropriate explanations must be provided constantly. The use of child life specialists and pediatric-trained psychosocial responders can help an evacuating pediatric patient cope with potential fears and confusion associated with the event. Increased security is necessary because children are at higher risk for unintentional separation from a parent or guardian. Although extremely challenging, tracking children throughout the evacuation process is essential because children may not be able to identify themselves or family members.

In every evacuation plan, there is a small segment of pediatric patients that cannot follow the standard plan. For example, patients with cystic fibrosis who harbor *Burkholderia dolosa* should be directly transported. Ideally, this group of patients should be cohorted to decrease spread to other cystic fibrosis patients. Immunocompromised patients should also be directly transported to the receiving facilities. Patients who are currently receiving life-saving care such as extracorporeal

membrane oxygenation and high-frequency ventilation will need specialized protocols and resources for transfer.

ALTERED STANDARDS OF CARE

Altered standards of care (ASC) is a topic of concern for many public health officials and health care providers. The failure to create a plan to address ASC will result in the perception of unjust allocation of resources, or actual unjust allocations.[22] The Massachusetts Department for Public Health guidelines for the development of ASC include (1) maximize positive patient outcomes when health care needs exceed available resources and (2) establish principles and guidelines to assist health care providers to continue to provide care in an ethical manner during circumstances that make delivery of [normal] health care…difficult, if not impossible.[23] A summary of specific ASC suggestions was outlined by a task force assembled by the American College of Chest Physicians. The task force organized their suggestions into categories including (1) optimizing surge capacity, (2) medical resources, and (3) a framework for allocation of scarce resources in mass critical care.[22] Although work on developing comprehensive pediatric-altered care standards for hospitals has begun, significant gaps still exist.

SUMMARY

Children are among the most vulnerable populations effected by disasters. Once a community has been impacted, the opportunities to build pediatric capabilities in a "just in time" fashion will be severely limited. The most successful planning efforts will include the needs of children and build on daily operational strategies. Hospital-based planning must anticipate and respond to the unique aspects of pediatric emergency preparedness.

ACKNOWLEDGMENTS

This work was supported in part by Emergency Medical Services for Children Targeted Issue grant H34MC10575. Supported in part by Health Resources and Service Administration (EMSC Targeted Issues) Grant # H34MC10575.

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