Pediatric Disaster Preparedness: A Resource for Planning, Management and Provision of Out-of-Hospital Emergency Care

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Foreword

A review of the current state of readiness for disasters and terrorism with regard to the needs of children reveals significant gaps both in emergency preparedness (preparation and protection) and in disaster management (response and recovery). Historically, the unique characteristics of children and their lives have not been well or fully considered in the multidisciplinary planning process for response to terrorism, most especially in the prehospital environment. Why is this so? In the past, much of the terrorism response planning in the United States has centered on military preparedness. Therefore, plans have focused on the needs of adults. Unfortunately, the entire population is now at risk. As the planning for disasters and terrorism is undertaken, it is time to reassess education and preparation for all catastrophic events to ensure that children and their families are included. Unfortunately, the care of children during such events cannot be approached simply by modifying current practices. Basic day-to-day issues involving families that have not been previously considered (incorporating schools and childcare centers into disaster preparation and protection) must now be addressed. The likelihood of a disaster occurring while children are in school or at childcare centers is high. Disasters could also occur at a school, on a school bus or at a childcare center.

Emergency Medical Services (EMS) agencies and their dedicated providers comprise the initial medical response to every day emergencies, disasters – whether natural or man-made – and other public health emergencies – such as pandemic influenza – that may arise. Regional, state and national planning requires EMS leaders and emergency managers to plan together and coordinate services. It is well documented that preparing for the needs of children is challenging, therefore uneven. Resources such as the AHRQ-AAP published Pediatric Terrorism and Disaster Preparedness Resource http://www.ahrq.gov/research/pedprep/pedtersum.htm and the New York City Department of Health and Mental Hygiene Pediatric Disaster Toolkit: Hospital Guidelines for Pediatrics during Disasters (2nd Edition, 2006) http://www.nyc.gov/html/doh/html/bhpp/bhpp-focusped-toolkit.htm (3rd Edition pending) are available for reference.

This latest document, Pediatric Disaster Preparedness: A Resource for Planning, Management and Provision of Out-of-Hospital Emergency Care – prepared by Center for Pediatric Emergency Medicine for the Emergency Medical Services for Children (EMSC) National Resource Center, under funding provided by the Federal EMSC Program of the Maternal and Child Health Bureau (MCHB), Health Resources and Services Administration (HRSA), United States Department of Health and Human Services (HHS) – has been designed to focus on the practical and essential elements of pediatric prehospital emergency care in EMS system planning for disasters and terrorism. It is designed for use by EMS agency and system medical directors and administrators, emergency managers, and any other key stakeholders who will be concerned with the functions and activities of EMS care providers during a disaster, terror event, or other public health emergency. Content has been compiled by experts from around the country to reflect the current evidence base, best practices and practical application, and covers clinical, administrative, and policy issues. The hope is to facilitate planning and save valuable time. The purpose of each section is to supplement the planning, approaches, and knowledge that already exist to facilitate integrating specific pediatric topics that will enhance preparations in a practical and additive manner.
Incorporating the needs of children and families into terrorism and disaster planning requires multidisciplinary pediatric expertise at all phases. *Pediatric Disaster Preparedness* includes the information available using the best evidence known to include children and families in all types and at all levels of terrorism and disaster planning. A few of the many considerations include the following:

- Writing and implementing child-specific protocols
- Planning for children who are separated from their parents and at schools and childcare centers when disaster strikes
- Training providers to care for the pediatric patient
- Developing equipment and medication dosage forms and delivery systems appropriate for children
- Providing education on the recognition and care of mental health needs of children in the aftermath
- Planning for children with special health care needs

The following topics are covered, but we plan to expand the coverage in future editions based on feedback and identified needs.

- How Children are Different
- Triage
- EMS System Disaster Plan
- Transport Plan
- Shelter Care
- Disaster Drills
- Decontamination
- Psychosocial
- Patient Identification and Tracking
- Types of Disasters
- Physical Disasters
- Biological Disasters
- Children with Special Health Care Needs
- Equipment

Planning and preparation for terrorism and disasters can be both daunting and challenging. For all, but especially for children and families, there are many recognized gaps in knowledge, resources, and professional education. This resource has been provided to increase pediatric expertise of those who are willing and ready to take on the challenge of preparation and planning. This resource can also be used by other pediatric health care providers, public health professionals, health administrators, and policy makers who are committed to ensuring that planning for terrorism and disasters includes the special needs of children.
Foreword

Pediatric Disaster Preparedness

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Introduction

“Pound for pound, children breathe, drink, and eat more than adults.”¹

Disaster medicine is defined as the field of medical specialization that provides medical care to disaster survivors, and is concerned with medically related disaster preparation, mitigation, response and recovery leadership throughout the disaster life cycle.² While the overriding purpose of all emergency preparedness and disaster management is the preservation of human life – stabilization of the disaster response and protection of vital property, both public and private, are also important, but are clearly secondary to the preservation of life. Disaster medicine differs from day-to-day medicine in that a far larger array of public health and safety services must be involved in the disaster response to ensure a safe environment for patients and providers alike. That children have special needs in disasters should not be surprising – they also have special needs on a daily basis. Thus, all emergency responders, most especially emergency medical services (EMS) personnel, must accept the fact that since nearly all disasters will involve children, they must be ready to provide for their needs.

Readiness for pediatric disaster medical care is best accomplished through readiness for pediatric day-to-day medical care. The EMS agencies and systems that are best situated to respond to disasters involving children are those which have made special provision for pediatric care at every level of organization – medical oversight, provider training, proper equipment and medications, in all appropriate sizes and dosages, as well as patient safety and performance improvement programs that address pediatric issues. The other sections in this resource will provide EMS leaders with the tools they need to prepare for the day when disaster strikes, and children are hit – as they were, at the very moment of this writing, by a tornado that touched down in a Boy Scout camp in southwestern Iowa, an area sparsely populated and even more sparsely served by specialized pediatric clinics and hospitals. This section will focus on the design and function of the EMS system in disasters involving adults and elders as well as children – understanding that children can be expected to fare no better than these others, since the integrity of the pediatric disaster response will be dependent on the integrity of the medical disaster response overall.

The Public Health Paradigm of Disaster Medicine:

“Preparation, Mitigation, Response, Recovery”

The public health paradigm of disaster medicine consists of four distinct phases. The first two – preparation and mitigation – together comprise what is called “emergency preparedness”, the last two – response and recovery – “disaster management”. The first three are within the domain of all health care personnel, since all health care agencies and organizations must 1) prepare themselves through planning and education to respond to disasters requiring a medical response, 2) mitigate the immediately detrimental health effects of disasters through use of organized systems of care delivery, and regular drills that refine the ability of health care organizations to respond in an effective manner, and 3)
respond in priority order to suddenly ill or injured patients with sufficient resources and personnel to meet their needs, through application of a scientifically validated triage tool, and mobilization of surge capability adequate to provide minimally acceptable care to all patients requiring health care services. The last phase, recovery, is chiefly the responsibility of the public health system, although acute care professionals, including emergency medical personnel as well as acute care physicians and nurses from the disciplines of emergency medicine, trauma, and critical care medicine, may be called upon to assist both primary care and public health physicians and nurses provide urgent health care to a population requiring both primary care and acute care during the interval during which the public health and health care infrastructure is reestablished and rebuilt.

The public health paradigm of disaster medicine is directly analogous to the public health paradigm of injury prevention.

The first phase of injury prevention – primary injury prevention, or avoidance – is designed to keep injuries from occurring in the first place, chiefly through planning and education, based on the epidemiology of injuries in the community being served; preparation for disasters, through planning and education, also forestalls many of the untoward medical effects of disasters.

The second phase of injury prevention – secondary injury prevention, or attenuation – is designed to lessen the impact of injuries as they are occurring, based upon engineering solutions that alter the systems and environment within which these injuries commonly occur and treatment is provided; mitigation of disasters, via implementation of an incident command system, and regular disaster drills, lessens the medical effects of disasters by ensuring a prompt, organized medical response.

The third phase of injury prevention – tertiary injury prevention, or amelioration – is designed to reduce the effects of injuries that have already occurred, based upon evaluation strategies that address patients’ needs in order of physiologic important; response to disasters similarly decreases medical complications by prioritizing care when multiple casualties are involved, via triage, and determining the immediate need for and urgent availability of additional assets in terms of equipment as well as employees, known as surge capability rather than surge capacity, since it matters not what additional assets may be on hand, but rather, which can actually be used.

Key Differences between Disaster Medical Care and Day-to-Day Medical Care:

“Circumstances Extraordinary, Care Ordinary”

The most important difference between disaster medical care and day-to-day medical care is the number of patients who must be assessed and managed. Multiple casualty incidents (MCIs) typically involve five or more patients; the resources of the involved EMS agencies may be strained, but are not overwhelmed. By contrast, mass casualty events (MCEs) typically involve twenty or more patients; the resources of the involved EMS systems as well as agencies will be spent, and are completely overwhelmed. Understanding the massive gap that may suddenly appear between patients’ needs and available resources, and the chaos that inevitably results, is critical to EMS system design and function in the disaster situation – stated succinctly, care will have to be rationed, if only for a short time; desperately ill or injured adults and children may need to wait until others with greater likelihood of survival
are treated first; and EMS providers will need to make such life-and-death decisions in the blink of an eye, and in the midst of the worst possible environment for health care: a crowded, possibly smoke- or gas-filled scene, characterized by loud noises, screaming patients, putrid odors, gruesome deformities, and crowds of individuals with little or no training either trying to help but getting in the way, or worse, taunting EMS providers as they attempt to make the best of a bad situation.

The other key differences between disaster medical care and day-to-day medical care involve the mechanisms of illness and injury encountered, and the environment in which emergency medical care must be delivered. As most natural and human-made disasters involve physical trauma, EMS personnel must be prepared to provide urgent care to many types of blunt and penetrating injuries, which may result from numerous types of events – crush injuries from earthquakes and structural collapses, near drownings from hurricanes and floods, blast and burn injuries from explosive and incendiary devices such as bombs and industrial mishaps, and firearm injuries from gunshots and military ordnance, to name but a few, not to mention the contaminated wounds associated with all the above. Chemical, radiological, and nuclear disasters – including both hazmat exposures and terror events – are like physical trauma in that the onset and duration of most such events are sudden and limited, although specific medical treatments may be required for care of injured patients. Biological disasters, however, require an entirely different approach to their care – since infected patients are not likely to require emergency medical care at precisely the same time, but rather will present in “clusters” of individual patients with like symptom complexes which, when recognized as such, will likely require an approach to management that involves cohorting of patients, and specialized personal protective equipment (PPE) for emergency medical providers, and sometimes for patients as well.

**Approach to Emergency Medical Care in Pediatric Disaster Medicine:**

“KISS – Keep It Simple, Sister (And Brother)”

The emergency medical care provided during disasters is but one aspect of the overall emergency response to disasters. Emergency management of disasters follows an “all hazards” approach, to allow one easily remembered approach to be applied to all types of disasters, reserving and limiting specialized plans for and to only those components of the disaster response that require specialized interventions. Emergency medical responders will rarely, if ever, find themselves “in command” of a disaster scene, since their skills are far too valuable to waste on scene safety and crowd control, tasks which are far better handled by public safety officials specially trained and authorized to perform these tasks. On the other hand, it must be understood that the highest ranking medical professional on the scene is responsible for medical incident command, and his or her medical orders are regarded as binding, unless there is an urgent threat to the safety of patients or providers.

The approach to emergency medical care in disasters must follow a standardized pattern if all involved providers are to understand their roles and collaborate effectively. One such model is the D-I-S-A-S-T-E-R Paradigm developed by the National Disaster Life Support (NDLS) Foundation, and disseminated via the NDLS series of courses – Core Disaster Life Support (CDLS), Basic Disaster Life Support (BDLS), and Advanced Disaster Life Support (ADLS) – that it now offers in collaboration with the American Medical Association (Table 1). The critical elements of the D-I-S-A-S-T-E-R Paradigm will be familiar to all EMS leaders, managers, and providers, in that Safety and Security, and Assessment of Hazards, precede Triage and
Treatment in all cases, as they do for routine care. The only differences, aside from Recovery, which is not ordinarily within the purview of EMS are 1) Detection and Declaration of the disaster, 2) implementation of an Incident Command Structure, before emergency medical care is provided, 3) use of disaster specific Triage and Treatment protocols that permit only minimally acceptable care to be provided to salvageable patients, prior to 4) rapid Evacuation from the scene – ideally, in the case of children, to pediatric capable healthcare facilities, either fixed or deployable – recognizing that since all healthcare facilities may be called upon to care for children in disasters, all must prepare themselves to do so; fortunately, tools are now available that can assist non-pediatric facilities in meeting their responsibilities to children in disasters (http://www.nyc.gov/html/doh/html/bhpp/bhpp-focus-ped-toolkit.shtml).

Environment of Emergency Medical Care in Pediatric Disaster Medicine:

“Uphill, Upwind, Upstream”

As for any emergency medical response, scene safety and personal protection are of paramount importance in the disaster medical response. The environment, in which emergency medical care must be delivered, however, presents special challenges to emergency medical responders. The scene itself may be contaminated, or contain single or multiple secondary hazards, placed unintentionally or intentionally, that may further injure patients and providers alike. Thus, despite the risk of further patient deterioration, emergency medical responders must NOT enter the scene unless and until it has been declared safe by the appropriate public safety authorities – a directive that will be very hard, if not impossible, to enforce when children are victims, but which must be enforced nonetheless, since EMS personnel who become ill or injured while caring for others, by definition, become part of the problem rather than part of the solution, and unwittingly serve to diminish the capability of the very emergency response they seek to augment.

The environment in which emergency medical care is provided in disasters depends upon the specific type of disaster involved. However, the deployment of emergency medical personnel in the field always follows the same general pattern which keeps specialized personnel – especially vital medical personnel – uphill, upwind and upstream, of the dangers posed by the scene to providers untrained in rescue (Figure 1). EMS personnel never enter the search and rescue (SAR) area (“hot zone”) unless directed by responsible authorities once it has been declared free of hazards, even to rescue distressed pediatric patients, but receive all suddenly ill and injured patients, whether adults or children – once they have been at least grossly decontaminated, if decontamination is indicated – for transport to nearby “fixed” or “deployable” medical facilities at one or more casualty collection points (CCPs) within the overall area of operations (“warm zone”) located inside the external perimeter, which is never crossed without specific orders. In some disasters – particularly those in which EMS resources, especially ambulances and multiple emergency response vehicles (MERVs) are of limited availability – it may be necessary on a temporary basis to establish a staging area for initial treatment of victims by emergency medical personnel, in which case it may be advisable to separate children from adults, though not from their families; still, rapid evacuation is always the priority, ideally, in the case of children, to healthcare facilities that have made special provisions for their needs, and of which EMS personnel must be aware as part of their training.
The Role of Emergency Medical Services in Pediatric Disaster Medicine:

“Children Are Not Small Adults”

Emergency medical personnel, as acute care professionals, are chiefly involved with the third phase of the public health disaster paradigm, namely, disaster response – and, under the revised National Response Framework (NRF) that became effective in March 2008, function as part of Emergency Support Function Number 8 (ESF #8). The fundamental principle of emergency medical care in disasters is to provide the greatest good for the greatest number. This is in contrast to what emergency medical professionals do every day, namely, to provide all necessary care, within the limits of equipment, resources, and personnel available in the prehospital environment, to patients requesting emergency aid. To provide emergency medical care in disaster therefore requires an important shift in the mindset of emergency medical personnel, from the optimal care provided to the suddenly ill and injured patient, to the minimally acceptable care offered to a distressed population.

Minimum acceptable care is that which is urgently necessary to save life or limb, but no more – care which, by its very nature, is sustentative rather than definitive. Temporizing basic life support (BLS) measures in support of the airway, breathing, and circulation – the ABCs – are the fundamental elements of minimally acceptable care for children and adults alike, recognizing that such care in children requires the ready availability of the appropriate pediatric equipment. However, note that in mass casualty events (MCEs), when treatment resources may be severely limited, there will likely be time only for the primary, or initial, assessment, not for the secondary assessment, also known as the focused history and detailed physical examination – just as there will be no time for advanced life support (ALS) interventions that consume scarce, and valuable, minutes. EMS personnel must also be aware that, despite their natural and admirable tendency to want to save the lives of children before those of adults, no time should be spent in futile attempts at caring for children who are deemed unsalvageable – although comfort care, and psychological first aid, can and must be made a priority for all children, especially if they have been separated from their loved ones or their regular caregivers, once minimally acceptable care has been given to all salvageable patients, child or adult.

Application of Incident Command Systems (ICS) in Pediatric Disaster Medicine:

“Who’s In Charge? They're All In Charge!”

The Incident Command System (ICS) now in common use in the United States resulted from the experiences of those battling California wildfires in the 1970s and 1980s. To contain these fires, the services of numerous agencies from several states were required. Unfortunately, the involved agencies used different command structures as well as radio frequencies, making it difficult, and in many cases impossible, to communicate between agencies. As a result, the lives of several firefighters were unnecessarily lost, leading experts in firematics to partner with those in management to develop a universal system for incident command built on the principles of Management by Objectives and Results – a system recently adopted and endorsed by the Department of Homeland Security (DHS) as a fundamental component of the National Incident Management System (NIMS) and the National Response Framework (NRF), and taught in all its training courses (Table 2). The Incident Command System (ICS) now in place employs four Staff Officers as part of its
Command Staff, Liaison, Medical/Technical, Public Information, and Safety, easily remembered by the mnemonic, “[Mount] OLMP$”; and four Section Chiefs to comprise its General Staff, Finance/Administration, Logistics, Operations, and Planning, easily remembered by the mnemonic, “C-FLOP” (Figure 2).

In addition, the Incident Command System (ICS) now in place is based on the principle of Unity of Command – the premise that, while informal sharing of information is strongly encouraged at every level of the Incident Command Structure, formal briefings, orders, and reports flow from, to, or through only a single supervisor, whose Span of Control does not exceed three to seven, and ideally only five, subordinates. While Incident Command may be shared by designated officers of multiple agencies with primary jurisdictional authority and responsibility, one of whom will act as the spokesperson – a structure known as Unified Incident Command – all participating agencies and personnel, even though their focus will be to provide an effective disaster response within their individual areas of expertise, agree to report via various Section Chiefs to a single locus of Incident Command, supported by Staff Officers who assist Incident Command with certain command functions. The implementation and operation of this Incident Command System should be well known to EMS leaders making use of this resource, and thus will be summarized diagrammatically rather than explained in detail (Figure 2). Suffice it to say that 1) under all the but most unusual circumstances, EMS will serve as a support rather than a command agency, and confine its operations to triage, treatment, and transport of the acutely ill and injured, and 2) the provision of pediatric emergency care must be the responsibility of all involved EMS agencies and personnel, since children requiring such care will be encountered in all disaster venues.

Planning for the Care of Children in Disasters:

“Plans are nothing. Planning is everything.”4

The enormous variability in disaster type and venue makes disaster planning a daunting challenge, even for experienced professionals; however, absent comprehensive planning, and without due consideration of all likely disaster scenarios, it will be impossible to mount an effective disaster response. Fortunately, the very act of planning for every eventuality yields rich dividends in terms of preparation; numerous sources have cited their extensive preparations for Y2K as instrumental in managing disasters that occurred subsequently. With respect to children, suffice it to say that pediatric victims should be expected following most disaster events, and may be the specific targets of certain terror events; disaster venues most likely to harbor pediatric patients include schools, school buses, playgrounds, recreational areas, athletic fields, amusement parks, shopping malls, and entertainment complexes. EMS leaders must work with the managers of all such facilities well in advance of any possible terror threat to ensure they have developed detailed disaster plans, especially for evacuation, in the event of terror attack – plans that must be coordinated with those of local public health and safety agencies and local and regional emergency medical services and trauma care facilities, in addition to EMS.

In developing such plans, EMS leaders must involve not only child health professionals expert in both physical and psychological trauma, but also peers, parents, religious leaders, and civic leaders, to ensure that disaster and evacuation plans have addressed all foreseeable calamities. Most venues delineated above have community advisory boards or liaisons, who together with facility directors must take the lead in ensuring that plans are not only developed and reviewed, but also are current, realistic, sensible, and flexible, and perhaps
most important, both easy to remember, and easy to implement. Exits must be well lighted, preferably with natural light as most terror attacks targeting children will occur during the day, and well marked, at ceiling, wall, and floor levels, to facilitate rapid recognition even by small children or when visibility is poor. All disaster and evacuation plans must then be tested and refined through regular drills, to ensure that children will understand, and will have practiced, what to do if and when a disaster should occur.

Training for the Care of Children in Disasters:

“Remember the ABCs, But If That’s Too Difficult, Remember the AAA’s”⁵

All EMS personnel involved in disasters must be well trained in the application of the National Incident Management System (NIMS), and must be thoroughly familiar with the specifics of the Incident Command System (ICS). At a minimum, therefore, all EMS professionals must have successfully completed the IS-100 (Introduction to the Incident Command System), IS-200 (ICS for Single Resources and Initial Action Incidents), IS-700 (National Incident Management System – An Introduction), and IS-800B (National Response Framework – An Introduction) courses offered by many states, and educational consortium partners of the Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA), readily accessed on line at http://training.fema.gov, while all EMS leaders and most EMS supervisors should also have successfully completed IS-300 (Intermediate ICS for Expanding Incidents) and IS-400 (Advanced ICS for Command and General Staff – Complex Incidents), accessed at the same address, but which must be taught by qualified instructors over three days each, due to the breadth and depth of the material to be covered, and the large amount of small group work involved. All EMS personnel must also be well trained in the EMS response to MCI’s and MCEs potentially involving weapons of mass destruction (WMD). Thus, all EMS professionals should have successfully completed AWR-160 (WMD Awareness Level Training), while all EMS leaders and most EMS supervisors should also have successfully completed PER-211 (EMS Operations and Planning for WMD Incidents), offered by DHS and FEMA.

Training specific to pediatric emergency care in disasters is based upon a solid grounding in pediatric emergency care for day-to-day pediatric emergencies – recognizing that for most pediatric emergencies, respiratory distress, failure, and arrest, rather than shock, are the final common denominators of physiologic deterioration. All EMS personnel should successfully complete the Pediatric Emergencies for Prehospital Professionals (PEPP) Course of the American Academy of Pediatrics at either the basic life support (BLS) or the advanced life support (ALS) level, as appropriate (http://www.pepp.org), while advanced life support (ALS) personnel should also successfully complete the Pediatric Advanced Life Support (PALS) Course of the American Heart Association and the American Academy of Pediatrics.⁶,⁷ The Basic Disaster Life Support (BDLS) and Advanced Disaster Life Support (ADLS) Courses of the American Medical Association and the National Disaster Life Support (NDLS) Foundation directly address pediatric disaster emergency care within the context of disaster care for all ill or injured patients (http://www.bdls.org).³ Finally, the Pediatric Disaster Life Support (PDLS) Course developed by the University of Massachusetts School of Medicine at Worcester for the Federal EMSC Program offers a compact, and highly effective, review of the fundamental principles of disaster medicine and pediatric disaster emergency care.⁸
Equipment for the Care of Children in Disasters:

“Amateurs study tactics. Professionals study logistics.”4

Children cannot be resuscitated optimally using tools designed for adults. Every EMS professional must therefore be trained using pediatric equipment, and such equipment must be universally available on ambulances and similar rescue vehicles throughout the EMS system. The costs of equipping even a single ambulance with the proper equipment in all appropriate pediatric sizes pale before the expense of providing a single automated external defibrillator for the same ambulance. The opportunity for a successful resuscitation is far higher, given that most pediatric emergencies are respiratory in nature. Since assisted ventilation is the most important skill emergency medical technicians and paramedics may possess, the provision of bag-valve devices and clear plastic face masks with inflatable rims in all appropriate pediatric sizes is of paramount importance to the prehospital care of acutely ill and injured children – as is the ready availability of a length based, color coded resuscitation tape, to ensure proper equipment and dosage selection.

The Federal EMSC Program periodically revises a recommended pediatric equipment list for ambulances, as do the American College of Surgeons and the American College of Emergency Physicians, who jointly produce a similar document at regular intervals.9,10 All EMS agencies should endeavor to ensure that their fleet maintains this equipment on all its vehicles, which is available – often from affiliated hospitals – at trivial expense. While no special equipment is required for management of physical trauma, respiratory illnesses spread by airborne droplets mandate the availability of properly fit tested N-95 respirators for all front line staff. Other than the proper personal protective equipment (PPE) required for use in contaminated environments – most urban EMS agencies outfit their personnel with Level C equipment, including liquid-impenetrable suits and powered partial air-purifying respirators (PAPRs) – the only additional equipment needed by most EMS agencies will be atropine, pralidoxime, and diazepam autoinjectors in pediatric and infant sizes as antidotes for nerve agent poisoning, and for EMS agencies located near nuclear power facilities, potassium iodide tablets, which can be halved or quartered as needed.

Drilling for the Care of Children in Disasters:

“Talkin’ The Talk vs. Walkin’ The Walk”

Drills and exercises are a vital component of the mitigation activities every healthcare organization, whether an EMS agency or a healthcare facility, must undertake to be ready to provide disaster care. The first step for all those responsible to conduct disaster drills and exercises is to perform a hazard vulnerability analysis (HVA) – a full and complete inventory of possible disasters that might affect the EMS agency or healthcare facility. A properly performed hazard vulnerability analysis will 1) focus on events internal as well as external to the agency or facility, 2) emphasize those hazards felt likely to have the greatest impact on the function of the organization, 3) consider the likelihood that such events might occur, and 4) determine how such events might affect the agency or facility. Disaster drills and exercises can then be constructed to test organizational readiness for one or more of the possible scenarios that have been considered – the results of which, summarized in After Action Reports (AARs), are used to further refine the disaster plan.
Readiness for disasters is first tested via *tabletop exercises* – verbal or written scenarios that evaluate the effectiveness of an agency’s or facility’s emergency management plan and coordination. Next utilized are *disaster drills* – supervised activities with a limited focus designed to test procedures that are limited components of an agency’s or facility’s emergency management plan. Only then are *functional exercises* mounted to simulate a disaster in the most realistic manner possible without moving real people or real equipment to a real site, ideally as a prelude to *field exercises* – culmination of previous drills and exercises that tests the mobilization of as many as possible of the response components in real time, using real people and real equipment. To accurately assess an agency’s or facility’s response with respect to the pediatric component of any disaster, of course, it is necessary to include “pediatric victims” as part of these drills and exercises – most authorities recommend that 5-10% of all “disaster victims” be children and infants.

**Special Considerations in the Care of Children in Disasters:**

*“Failing To Plan Is Planning To Fail”*12

Reunification of children with parents, siblings, and classmates must be addressed as part of all disaster plans. Disasters involving children naturally result in profound emotional and behavioral responses on the part of all concerned. Provisions must be made to assure the safety not only of the children themselves, but also of concerned relatives who appear on scene to rescue their youngsters. Support services must be immediately available in such crisis circumstances, particularly pastoral care and mental health services, as well as social services to see to the immediate needs of involved families – especially for information about the whereabouts of children who are injured, those whose parents or siblings have been injured or killed, and those not yet been reunited with their families.

As is also true of adult nursing home patients, children with special health care needs (CSHCN) due to chronic illnesses or injuries, including technology assisted children (TAC), present special challenges to EMS agencies and systems. First and foremost is knowing who and where they are – many such children are cared for at home, without the knowledge of the local EMS agency or regional EMS system. Parents of children with special health care needs are encouraged to complete a special form, available from the American Academy of Pediatrics and the American College of Emergency Physicians, detailing the nature and extent of their child’s medical problems, and keep it on hand for EMS personnel who may from time to time be called upon for assistance.11 If possible, a copy of the form should be provided to the local EMS agency, so that advance plans can be made for a child with special health care needs who may require rapid evacuation.

**Summary**

It is self evident, based on the foregoing, that children and young adults are at high risk of injury following disasters. They are at higher risk of serious physical injury than adults, for several reasons: 1) flexible bones cause fewer fractures to serve as trauma markers, 2) internal organ damage is often overlooked, 3) vital sign screening is frequently inadequate, and 4) body heat loss is naturally increased during exposure or following decontamination, due to the larger body surface area to mass ratio in the child. They are also at higher risk of exposure to biological, chemical, radiological, and nuclear toxins that adults, again for several reasons: 1) their immune systems are less well developed, owing both to immaturity, and to
lack of previous exposure to many biological vectors, 2) they are smaller and closer to the ground, therefore more likely to inhale and ingest heavier than air gases or contaminated particulate matter, 3) their metabolic rates are higher, resulting in faster rates of breathing, hence more rapid absorption of toxic vapors, and 4) their skin is thinner, making them more vulnerable to the effects of beta radiation. Moreover, children can be expected to be involved in most, if not all, disasters involving any community, and have been the actual targets of terror attacks in certain situations – witness the number of senseless shootings that have plagued our nation’s high schools.

To ensure that the special needs of children are addressed in the prehospital environment, child health professionals must be involved in all aspects of emergency management. The term “emergency management” refers to a new public safety discipline, the role of which is to coordinate all aspects of a regional response to a natural or manmade disaster, while the term “emergency preparedness” refers to the state of readiness needed by a community to respond optimally to a natural or human made disaster. Although it is the unequivocal responsibility of EMS agency and system leaders and managers to involve pediatric experts in both local and regional disaster planning and emergency preparedness activities, their training often overlooks the special needs of pediatric patients. Thus, it is incumbent upon child health professionals to involve themselves in all aspects of the EMS system response commensurate with the scope and range of their practices, through governmental and community advisory boards, and multidisciplinary committees on pediatric emergency medicine and disaster management organized and supported by local branches of the American Academy of Pediatrics and American College of Emergency Physicians, in partnership with local and regional healthcare facilities and organizations.

**References**

4. Attributed to Dwight D. Eisenhower.
5. Attributed to Martin R. Eichelberger.
9. EMSC ambulance equipment list.
10. ACS/ACEP ambulance equipment lists.
11. EMSC CSHCN form.
12. Attributed to Benjamin Franklin.
Table 1. The D-I-S-A-S-T-E-R Paradigm

D  Detection / Declaration
I  Incident Command
S  Safety / Security
A  Assess Hazards
S  Support Services
T  Triage / Treatment
E  Evacuation
R  Recovery
### Table 2. Department of Homeland Security ICS and EMS Courses*

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS-100</td>
<td>Introduction to Incident Command Systems</td>
</tr>
<tr>
<td>IS-200</td>
<td>ICS for Single Resources and Initial Action Incidents</td>
</tr>
<tr>
<td>IS-300</td>
<td>Intermediate ICS for Expanding Incidents</td>
</tr>
<tr>
<td>IS-400</td>
<td>Advanced ICS for Command and General Staff – Complex Incidents</td>
</tr>
<tr>
<td>IS-700</td>
<td>National Incident Management System – An Introduction</td>
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<td>IS-800.B</td>
<td>National Response Framework – An Introduction</td>
</tr>
<tr>
<td>AWR-160</td>
<td>WMD Awareness Level Training Course</td>
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<tr>
<td>PER-211</td>
<td>EMS Operations and Planning for WMD Incidents</td>
</tr>
<tr>
<td>PER-212</td>
<td>WMD/Terrorist Incident Defensive Operations for First Responders</td>
</tr>
</tbody>
</table>

Figure 1. Schematic Diagram of a Disaster Site

A. Disaster Scene*

A Staging Area is where incident personnel await tactical assignment. The Base is the location where primary logistics functions are coordinated.

A helibase is where parking, fueling, maintenance, and loading of helicopters occur. The Incident Command Post is the location at which primary command functions are executed. Usually located with the Incident Base.

Camps are where food, water, rest, and sanitary services are provided to incident personnel. A helispot is a temporary location at an incident where helicopters can safely land and take off.

*Source: Center for Domestic Preparedness, Anniston, AL

B. Disaster Zones†

†Source: Society of Critical Care Medicine, Des Plaines, IL
Figure 2. Incident Command System in Common Use in the United States

A. Structure*

*Source: Center for Domestic Preparedness, Anniston, AL

B. Function†

†Source: Center for Domestic Preparedness, Anniston, AL
Chapter 2: How Children are Different

George Foltin MD, Jane Knapp MD

Principles of Disaster Triage

Many important differences distinguish children from adults and are the origin of the oft used truism “you can’t treat children as small adults.” Children have many unique anatomic, physiologic, immunologic, developmental, and psychological considerations that potentially affect their vulnerability to injury and response in a disaster. Failure to account for these differences in preparedness efforts, triage, diagnosis, and management of children is most often due to lack of knowledge or experience, or both. Unfortunately, grave errors can result, increasing the child’s risk of serious harm, and even death.

Anatomic Differences

An obvious difference between children and adults is size. Children are smaller than adults and vary in size depending on stage of growth and development. Their small size makes them more vulnerable to exposure and toxicity from agents that are heavier than air such as sarin gas and chlorine. These agents accumulate close to the ground in the breathing zone of infants, toddlers, and children.

A child’s smaller mass means greater force applied per unit of body area. The energy imparted from flying objects, falls, or other blunt or blast trauma is transmitted to a body with less fat, less elastic connective tissue, and closer proximity of chest and abdominal organs. The result is a higher frequency of multiple organ injury.

A smaller body has smaller circulating blood volume (on average 80 mL/kg) and less fluid reserve. These differences have several important implications. Volumes of blood loss that would be easily handled by the adult can produce hemorrhagic shock in children. Children are more vulnerable to the effects of agents such as staphylococcal enterotoxins or Vibrio cholerae that produce vomiting and diarrhea. Therefore, infections that might cause mild symptoms in adults could lead to hypovolemic dehydration and shock in infants, small children, or children with special health care needs.

The child’s skeleton is more pliable than that of adults. It is incompletely calcified with active growth centers that are more susceptible to fracture. Orthopedic injuries with subtle symptoms and physical findings are easily missed in preverbal children. Internal organ damage can occur without overlying bony fracture. It is common to have serious cardiac or lung injuries without having incurred rib fractures.

The pediatric cervical spine is subject to distracting forces that are more likely to disrupt the upper cervical vertebra and ligaments. There are numerous bony anatomic variations that render the interpretation of radiographs potentially confusing.

The mediastinum is very mobile in children. As a result, a tension pneumothorax can become quickly life-threatening when the mediastinum is forced to the opposite side compromising venous return and cardiac function.
The thoracic cage of a child does not provide as much protection of upper abdominal organs as that of an adult. Hepatic or splenic injuries from blunt trauma can go unrecognized and produce significant blood loss leading to hypovolemic shock.

Head injury is common in children. The head is a larger, heavier portion of a child’s body compared with that of an adult. It is supported by a short neck that lacks well-developed musculature. The calvarium is thin and vulnerable to penetrating injury, thus allowing greater transmission of force to the growing brain of a child. The brain doubles in size in the first 6 months of life and achieves 80% of its adult size by 2 years of age. During childhood, there is ongoing brain myelinization, synapse formation, dendritic arborization, and increasing neuronal plasticity and biochemical changes.

The airway differs between children and adults. The tongue is relatively large compared with the oropharynx, which creates the potential for obstruction of a poorly controlled airway. The larynx is higher and more anterior in the neck, and the vocal cords are at a more anterocaudal angle. The epiglottis is omega-shaped and soft. The narrowest portion of the airway is the cricoid ring, not the vocal cords as in adults. Airway differences combine to make the child’s airway more difficult to maintain as well as to intubate. The short length of the trachea increases the risk of a right mainstem bronchus intubation. The lungs are smaller and subject to barotraumas, resulting in pneumothorax with inappropriate ventilation.

The body surface area (BSA) to mass ratio is highest at birth and gradually diminishes as the child matures. The distribution of BSA also differs between children and adults. Children have a higher percentage of BSA devoted to the head relative to the lower extremities. This must be taken into account when determining the percentage of BSA involved for burn injuries and in situations of hypothermia treatment or prevention. The higher BSA to mass ratio also leads to more rapid absorption and systemic effects from toxins that are absorbed through thinner, less keratinized, highly permeable skin.

**Physiologic Differences**

Children differ physiologically in many ways from adults. They can compensate and maintain heart rate during the early phases of hypovolemic shock, which creates a false impression of normalcy resulting in resuscitation with too little fluid administration. This can be followed by a precipitous deterioration with little warning.

Vital signs including heart rate, respiratory rate, and blood pressure vary with age. Caretakers must be able to quickly interpret whether a child’s vital signs are normal or abnormal for age. Temperature is an often forgotten but important vital sign in injured children. The child’s ability to control body temperature is affected not only by the BSA to mass ratio but also by thin skin and lack of substantial subcutaneous tissue. These factors increase evaporative heat loss and caloric expenditure. Considerations of methods to maintain and restore normal body temperature are critical to the resuscitation of children. These can include thermal blankets, warmed resuscitation rooms, warmed intravenous fluids, and warmed inhaled gases.

Children have a higher minute ventilation than adults. This means that over the same period of time, they are exposed to relatively larger doses of aerosolized biological and chemical agents than are adults. The result is that children suffer the effects of these agents much more rapidly. Children are also more likely to absorb more of the substance from the lungs before it is cleared or diffused through ventilation.
Fluid resuscitation and drug dosages are based on the child’s weight. It is difficult to estimate the weight of a child, particularly for health care workers with limited pediatric experience. An easy, quick method for determining the child’s weight is to use the Broselow–Hinkle Pediatric Resuscitation Measuring Tape®. This tool rapidly provides many common drug dosages and fluid resuscitation volumes. Health care providers must also make appropriate fluid choices for resuscitation. Children who receive large volumes of hypotonic fluid are at risk of hyponatremia and seizures.

**Immunologic Differences**

Children have immature immunologic systems placing them at higher risk of infection (see also Biological Terrorism). Immunologically, children have less herd immunity from infections such as smallpox and a unique susceptibility to many infectious agents. One example, Venezuelan equine encephalitis, is usually a brief, self-limiting infection in adults. In children it can be severe with life-threatening encephalitis developing in 4% of victims. Children immunized with the currently available smallpox vaccine are more likely than adults to experience serious side effects such as encephalitis.

**Developmental Differences**

Developmental differences between children and adults are also readily apparent. Children, especially infants and toddlers, might be unable to describe symptoms or localize pain. Children rely on parents or others caretakers for food, clothing and shelter. Infants especially are vulnerable when their food sources are eliminated or contaminated.

In situations of disaster, the caretakers can be injured, killed in the incident, or not present. Children, especially infants and toddlers, are limited in their verbal ability to communicate their wants and needs. Children also have limited motor skills needed to escape from the site of the incident. Additionally, their cognitive development may limit their ability to figure out how to flee from danger or to follow directions from others or even to recognize a threat. The young child has a relatively limited ability to interact in stressful situations and an emotional state frequently dictated by that of their caretakers. A child’s reaction to danger or threat is influenced by their developmental stage, requiring familiarity with age-appropriate interventions.

**Newborn Developmental Characteristics (Birth–1 Month)**

**Muscle tone and body position**

- Mostly reflex movements
- Equal movement in arms and legs
- Extremities flexed at elbows and knees
- Cannot sit up
- Tightly grasps finger or other object placed in palm but does not reach for objects
- Reacts to loud hand clap or sudden movement with startle reflex (Moro reflex), straightening elbows and opening arms, then flexing elbows in a hugging motion
Mental status and social interaction

- Appears alert when awake, but does not turn to sound
- Looks at faces and objects but cannot follow their movement
- Has little facial expression
- Is not yet afraid of strangers

Verbal abilities

- No language abilities
- Cries when hungry, cold, startled, or in pain

Cognitive abilities

- Looks, listens, smells, and tastes to learn about the world
- Cannot understand words, but finds calm, continuous speech soothing

Infant Developmental Characteristics (1–12 Months)

Muscle tone and body position

- Has equal movement in arms and legs
- Flexion of extremities and Moro reflex begin to decrease at 4–6 mo
- Reaches for objects at 4–6 mo
- Begins to crawl at 4–10 mo
- Can be pulled into sitting position at 2 mo, but requires support
- Sits upright without support at 6–8 mo
- Stands at 12 mo

Mental status and social interaction

- Appears alert when awake
- Can focus on objects and follow their movement at 2 mo
- Smiles at 2 mo
- Turns to sound at 4–6 mo
- Begins developing fear of strangers at 6–8 mo
- Is consoled by presence of caregivers
Verbal abilities

- Begins imitating word sounds at 6–8 mo ("da da da," “ma ma ma”)
- Cries when hungry, startled, or in pain

Cognitive abilities

- Motivated by basic needs (food, water, warmth, touch)
- Looks, listens, smells, and tastes to learn about the world
- Cannot understand words, but finds calm, continuous speech soothing

Toddler Developmental Characteristics (1–3 Years)

Muscle tone and body position

- Walks by 18 mo
- Climbs stairs 1 step at a time by 18 mo
- Climbs stairs alternating steps by 3 yr
- Wriggles and squirms when restrained
- Falls more often due to increased mobility

Mental status and social interaction

- Is active when awake
- Social interaction is unpredictable: may fear strangers or act indifferent; may reach for objects or push hand away
- May run away if frightened
- May want to participate in care
- Feels modest about undressing
- Usually trusts those whom caregivers seem to trust

Verbal abilities

- Has basic language skills: a young toddler can understand simple words and phrases, an older toddler understands sentences
- Understanding of speech exceeds ability to express own thoughts
- May be talkative, but won’t always talk to strangers
Cognitive abilities

- Reasoning is just emerging
- Independence increases
- Random curiosity peaks, resulting in frequent injuries while exploring environment
- Views clothing and possessions as part of self and does not like having them removed
- Remembers and fears pain
- May believe illness or injury is punishment for bad behavior or thoughts
- Does not make up false symptoms
- Cannot reliably point to pain

Preschooler Developmental Characteristics (3–6 Years)

Muscle tone and body position

- Can walk, run, skip, and climb with great skill, frequent associated minor injuries
- Can ride a tricycle

Mental status and social interaction

- Is active when awake, but can sit still on request
- Accepts and interacts with strangers more readily, but may be slow to trust when ill or injured
- Can include others in games of make-believe
- Wants to initiate and control activities, which should be supported
- May be modest about being undressed

Verbal abilities

- Imitates adult conversation
- May use words that are not understood
- Believes others see things from own viewpoint, therefore may not explain clearly

Cognitive abilities

- Thinking is literal, concrete, and rooted in present time; may not understand concept of future events
- Thinks in absolutes (things are either good or bad; a laceration either hurts or doesn’t hurt)
2: How Children Are Different

- May not understand cause and effect (such as swallowing medicine to make pain go away)
- Views clothing and possessions as part of self and does not like having them removed
- May believe illness or injury is punishment for bad behavior or thoughts
- Engages in fantasy and magical thinking
- May attribute lifelike qualities to toys and objects
- Fears pain, separation from caregivers
- Begins to fear disfigurement
- Older preschooler may make up symptoms, which disappear with distraction
- Can reliably describe location of pain beginning around age 5

School-Aged Developmental Characteristics (6–12 Years)

Muscle tone and body position
- Physical skills are well-developed; better coordination reduces mishaps
- Injuries due to risk-taking behavior increase

Mental status and social interaction
- Has clear social skills
- Can appreciate another's point of view
- Quickly senses shame, anger, frustration in adults
- Is usually modest about being undressed

Verbal abilities
- Uses language to communicate thoughts and learn what others are thinking

Cognitive abilities
- Sees the world objectively and realistically
- Understands concepts involving past and some future events
- Engages in more flexible, relative thinking (a laceration may hurt a little or a lot)
- Understands cause and effect, and may be reasoned with (medicine will help pain go away)
- May make up symptoms, which become inconsistent with distraction
• Can reliably explain location of pain
• Quickly sees through falsehoods
• Fears pain, disfigurement, and loss of function
• Begins to grasp concept of death

Adolescent Developmental Characteristics (12–18 Years)

Muscle tone and body position
• Physical skills and coordination are similar to an adult’s, but may lack adult strength and endurance
• Risk-taking or impulsive behavior may result in injuries or illness

Mental status and social interaction
• Relates in direct, straightforward manner to adults who demonstrate respect
• Appreciates honesty
• Values privacy
• Is concerned about maintaining independence

Verbal abilities
• Language abilities approach adult levels, particularly in late adolescence

Cognitive abilities
• Engages in near-adult levels of abstract, objective, and rational thinking, but may have difficulty seeing adult perspectives
• Has solid understanding of right and wrong
• May be self-centered
• Is concerned about body image, scarring, and disfigurement
• May be greatly influenced by opinions of peers
• Is capable of making up or misrepresenting physical or mental symptoms
• Can reliably describe location of pain
• Can make decisions about care
Practical Considerations for Children and Families during Disasters

The anatomic, physiologic, immunologic, developmental, and emotional differences between children and adults give rise to many practical considerations for planning. (See also Unique Pediatric Needs.)

Emergency medical services (EMS) agencies should consider adopting triage tools such as JumpSTART® that use physiologic decision points adapted for ranges of pediatric normals and consider apnea as a potentially salvageable respiratory emergency.

Ambulances, clinics, and emergency departments typically carry only limited quantities of pediatric equipment. Sufficient supplies and equipment must be readily available to treat large numbers of child victims. Because equipment choices and drug dosages, including IV rates, depend on the child’s size, a quick, convenient system to guide appropriate equipment sizes and drug dosages must be in place. The system used must be comprehensive enough to include dosages for antidotes and other medications that may be relevant during a terrorist event.

The resuscitation of children can be further complicated by the technical difficulty of procedures such as intubation and intravenous access. Alternative methods for maintaining and securing the airway should be considered. When veins are small and/or constricted from shock or hypothermia, the equipment for alternative methods, such as intraosseous access, must be readily available.

Planning must consider all potential aspects of a child’s life. Therefore, it must account for children who are at home, in school or childcare, or in transit, as well as children who cannot be reunited with their families. School disaster plans should coordinate with community plans and should also consider post-incident stress management. Childcare centers and community youth centers should have disaster plans that focus on ensuring safety, accessing and interacting with community emergency responders, notifying guardians, and reuniting families.

Children are predisposed to illness and injury after a disaster for a variety of reasons. There can be lack of adult caretaker supervision, and the usual resources of school or childcare may be unavailable. Environmental hazards can be increased from collapsed buildings power tools, chemicals or unsecured firearms. Increased stress on adults might lead to a higher risk of domestic partner violence or child abuse. Infectious illnesses present in the community, especially infections such as respiratory syncytial virus or influenza, may spread rapidly in group shelters. Contaminated food or water can lead to epidemic outbreaks of infectious diseases, resulting in gastroenteritis and dehydration. Changes in the environment can lead to heat-related illness or hypothermia. Use of alternative sources for heating or generators can lead to carbon monoxide exposure. Children with asthma may have acute exacerbations due to stress or environmental contaminants. Medications may be forgotten or the supply may be exhausted, resulting in exacerbations of chronic illnesses. Stress can produce a variety of symptoms in children including headaches, abdominal pain, chest pain, vomiting, diarrhea, constipation, changes in sleep, and changes in appetite.

Planning must also include pregnant women and the unborn. The stress of a disaster can contribute to premature labor and delivery. Infection acquired by the fetus in utero can lead to fetal demise or devastating consequences if the fetus survives. The risk of developing cancer is higher in children who have been exposed to radiation in utero. Radioactive iodine is transmitted to human breast milk and threatens infants who are breastfeeding. Cows’ milk
can also be quickly contaminated if radioactive material settles onto grazing areas, threatening alternative sources of nutrition.

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3. Markenson D. COPEM Pediatricians Role in Disaster.
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Chapter 3: Pediatric Triage On-Scene in Disasters

Lou Romig MD

We’ve all had that sick feeling in the pit of our stomach when confronted with a badly injured or critically ill child. Imagine how you might feel when faced with numerous injured children and adults at a chaotic and perhaps hazardous scene. How would you proceed to set your priorities and try to assure that every patient received the best possible care under the prevailing circumstances? With crying, screaming and ominously silent small victims before you, could you make the objective decisions that will help your team maximize survival for the greatest number of your patients?

But let’s suppose you’re one of the lucky ones who has had appropriate training in disaster triage. Do you know and understand the differences between the event-based triage used in disasters caused by physical injuries, and the population-based triage used in large scale biological illnesses? If not, you may find yourself overwhelmed in a situation when pandemic influenza threatens your community.

Principles of Disaster Triage Following Physical Events

In order to grasp the principles of disaster triage, you must remember three “R’s” (Figure 1). The first “R” is resources. One of the most common definitions of a disaster is a situation in which needs outstrip the immediately available resources. In the EMS context, this means there are insufficient immediately available resources to meet the medical needs of all the disaster victims. In such a setting, the usual standards of medical care may not be realistically achievable.

The second “R” is relative. The scope of a disaster is relative to the amount of resources available in the local system. A multi-vehicle crash with 10 badly injured victims may constitute a disaster in a small town with very limited emergency care resources. You may need to make decisions that will result in resources being diverted from one or more of those victims in order to assure the survival of the greatest number of patients. The same crash in a large metropolitan area might be easily handled by a system rich in resources. Each patient might be able to receive the level of care they would receive if they had been the only victim in the crash.

The third “R” is rational. Rational action is one way to bring organization and control to a chaotic event. Triage in a disaster is probably more effective when medical decisions are made based on rational, objective criteria that are applied equally to all victims. No victim should receive a different level of treatment based only on irrational, emotion-based decisions. Preferential treatment for any victim or group of victims (such as children or a socially- or culturally-defined group) may result in an imbalance of resources that adversely affects the survival of other disaster victims. Without objective guidelines, providers may consistently err on the side of overtriaging kids because we instinctively want to give them every possible chance. If we triage all children to the most critical categories, we’re really not triaging them at all. Resources that will better benefit children (and adults) with survivable injuries may be consumed in fruitless resuscitative efforts for children with a low probability of survival. Rational, objective guidelines help assure that resources are directed in the most effective and efficient manner.
In summary, disaster-style triage should only be used in the setting of severe resource constraints that mandate a change in the standard of care that can be realistically delivered. In our daily medical practice we attempt to give every patient the best possible care, often consuming numerous resources, even when the chances of survival are very low. In disasters, when resources are insufficient to meet needs, our approach must change from doing the best for each individual to using the resources where they will provide the greatest benefit, even if that means some of the most critical patients will receive little to no medical care. Decisions about when to use disaster-style triage must be made on a system-by-system basis because they must take into account the relative amount of resources available locally. Triage must be performed based on objective, rational decisions in order to achieve the goal of doing the best for the greatest number of patients and maximizing survival.

**Why do we need pediatric disaster triage tools?**

The tools we use every day to make medical triage decisions in the prehospital and hospital settings are primarily based on observations of physiology. Assessment of mental status, respiratory function and circulation are included in every triage decision. Patients who are able to maintain a compensated physiologic state are usually triaged at a lower priority level than those who have decompensated. The physiology of children is different from that of adults; they have different physiologic strengths and vulnerabilities as well as different injury patterns due to their immature anatomy. It stands to reason that physiology-based triage tools must take into consideration the differences between adult and pediatric physiology. It could also be argued that we should have geriatric triage tools because the baseline physiology of the elderly varies from that of younger healthier adults. Adults and children must be triaged based on age-appropriate guidelines. This is true not only in our normal practice settings, but also in disasters.

**Pediatric triage tools must address pediatric physiology**

*Figure 2* lists some of the ways triage tools might need to be structured to be appropriate for pediatric physiology. Thresholds for vital signs must be appropriate for the wide ranges of normal found in children of different ages or stratified according to age groups. The parameters assessed must be quickly and accurately obtainable and commonly evaluated as a part of the normal medical practice of the providers performing triage. Two particular physiologic differences should be addressed.

First, children usually die from primary respiratory causes rather than the cardiac and circulatory causes usually seen in adults. Children’s hearts often don’t stop until they’ve been irreversibly damaged due to anoxia. Except when there is an acute blood or fluid loss, circulatory collapse follows respiratory failure. Adults’ hearts most often stop because of lack of circulation to the cardiac muscle; respiratory arrest usually follows circulatory deterioration. Apnea in an adult is more often an endpoint, whereas a child with apnea has a good chance of having circulation restored if bolstered immediately by effective ventilation and adequate oxygenation.

Second, appropriate pediatric neurological responses are dependent on age and developmental status. If the abilities to ambulate and/or follow commands are the only neurological parameters specified by the triage tool, all very young children and many older children with chronic disabilities and special medical needs would be triaged to more critical
categories simply because they were not judged by appropriate neurological standards. Although it’s probably better to overtriage than to undertriage, overtriage may result in children being subjected to stresses such as unnecessary procedures (IV insertion, spinal motion restriction) or unnecessary separation from their guardians and loved ones. At least one study of adult trauma triage algorithms suggests that the Motor Response component of the Glasgow Coma Score is a valid reflection of severity of injury. Because the Motor Response Score is easily applied to children, this may be the most appropriate measure of neurological status to use in a pediatric disaster triage tool.

**Pediatric Multicasualty (Disaster) Triage Tools**

Numerous EMS systems in the United States use their daily triage protocols or adult-oriented multicasualty triage tools to triage children in disasters. Trauma triage protocols in daily use often utilize the Glasgow Coma Score, Pediatric Trauma Score, mechanism of injury or other elements to determine which children need to go to established trauma centers. These tools were not developed to be used in the disaster setting and assume that adequate resources are available to meet the needs of all patients, no matter how gravely injured. This is a faulty assumption in a true disaster.

It is for this reason that the *Advanced Trauma Life Support*® Course of the American College of Surgeons makes a distinction between *multiple casualty incidents* (MCIs) and *mass casualty events* (MCEs). In the former, EMS resources are strained, but not outstripped. A good example might be a motor vehicle crash involving five or more victims for whom care must be prioritized, but is most often available within minutes. In the latter not only local EMS resources, but also regional EMS resources, are completely overwhelmed. In such circumstances, additional EMS resources may not be available for hours, or even days. As such, existing EMS resources must decide which patients will receive care first, and who must wait for care. Such decisions may be among the most difficult EMS professionals will ever be called upon to make, especially when they involve children, and it is for this reason that multicasualty triage tools are of such great importance to EMS professionals in disasters – they help the EMS professional make a good decision under bad circumstances. In actual practice, the terms “MCI” and “MCE” are used interchangeably in most EMS systems. Even so, multicasualty triage tools may useful even in MCIs, where it may be somewhat more obvious which patients require priority care. However, they are absolutely indispensable in MCEs, when decisions must be made quickly, with a minimum of evidence, yet with a high level of accuracy.

**MASS Triage**

The National Disaster Life Support (NDLS) Courses of the American Medical Association and the National Disaster Life Support Foundation – which include *Core Disaster Life Support* (CDLS), *Basic Disaster Life Support* (BDLS), and *Advanced Disaster Life Support* (ADLS) – all address these concerns, based on a two-step triage process. In the first step, “MASS” triage is applied. “MASS” is an acronym that stands for *Move, Assess, Sort, and Send*. To apply MASS triage in the field, the Incident Commander uses a megaphone or similar device to direct all patients within the sound of his or her voice to *Move* to a specified location, usually a staging area adjacent to the area of operations, for transport to a distant health care facility. Disaster victims who respond to this call have intact mentation, respiration, circulation, and ambulation, hence do not require immediate care. Once the scene has been declared safe, the
Incident Commander then directs small teams of properly garbed EMS professionals to briefly Assess the remaining victims based on physiologic status, using a scientifically vetted triage tool (discussed below), while simultaneously providing the minimum acceptable care to address the patient’s most immediate need, such as manual airway opening and/or external hemorrhage control. EMS professionals next Sort the victims based on both the acuity, and the severity, of their conditions, hence the urgency of the ongoing treatment needed – Immediate, Delayed, Minor, or Expectant (“IDME”) – then Send them via an appropriate transport vehicle, either ambulance, multiple emergency response vehicle (MERV), ambulance, or bus, to the closest health care facility appropriate to provide adequate care. The “Sort” step is the step when triage actually occurs, and for purposes of simplicity and convention, the four steps are typically color-coded as follows: Immediate = red, Delayed = yellow, Minor = green, Expectant = black. In some EMS systems, a fifth triage category is added for patients who are obviously dead, and will still be color-coded black, in which case Expectant patients are color-coded blue.

The most common adult-based MCI triage tool in use in the US and in areas around the world is START (Simple Triage And Rapid Treatment), developed as a collaborative effort between staff at Hoag Hospital and the Long Beach Fire and Marine Department in Long Beach, California. The tool assigns triage categories based on the ability to walk, presence of spontaneous breathing and respiratory rate, palpable pulses or capillary refill and the ability to obey commands. The use of the ability to walk and obey commands and the respiratory rate threshold of 30 breaths per minute make this tool suboptimal for use for pediatric victims. For more information, go the START website at www.start-triage.com.

Other adult-based MCI triage tools used around the world but not commonly utilized in the US include Careflight Triage (Australia), the Homebush Method (Australia), and the Triage Sieve (UK). Two tools designed specifically for pediatric MCIs and one tool with a pediatric modification are in use in the US and elsewhere internationally. The JumpSTART Pediatric MCI Triage Tool is the tool most commonly used in the US, followed by the Smart Tape™. The Sacco Triage Method™ (STM) addresses all ages and incorporates age-based adjustment factors for children and the elderly.

Recently, under the auspices of the Federal Centers for Disease Control and Prevention (CDC), a work group was convened at the behest of several large EMS organizations across the nation to decide which of the available multicasualty triage tools was best suited to use in the field by EMS. This action is analogous to that which led to the development of a single national model Incident Command System for common use in the United States, which is now taught by the Department of Homeland Security (DHS) in all its Incident Command System (ICS) courses. Known as “SALT” triage, for Sort, Assess, Life Saving Interventions, including hemorrhage control, airway opening, chest decompression, as well as autoinjector antidote administration, and Transport, this novel approach – which has not as yet been scientifically validated by EMS professionals in the field – seeks to combine the best features of all currently available triage tools, giving EMS professionals nationwide a single, standardized approach to field triage. In fact, most triage tools currently in use already comport with the SALT paradigm, so there may be little need to retrain of large numbers of EMS professionals in what is in reality an accurate mnemonic for the steps of EMS disaster care.
JumpSTART®

The JumpSTART Pediatric MCI Triage Tool was developed by Lou Romig MD, FAAP, FACEP, a pediatric emergency physician at Miami (FL) Children’s Hospital with field experience in EMS and disaster medicine. Designed to follow the same template as the START triage tool, which the designers state is to be used for patients weighing more than 100 pounds, JumpSTART (JS) can be used for children from birth to adolescence. Dr. Romig recommends that patients appearing to be “young adults” be triaged with an adult tool such as START and patients appearing to be less mature be triaged using JS. She avoids a strictly defined age cut-off because it is often difficult to accurately estimate the age of unconscious adolescent patients and anticipates that most EMS providers would define a “young adult” as being in the mid-teens, where the physiologic transition to adulthood is accomplished.

Figure 3 shows the JS algorithm. Patients are triaged into the conventional four color categories of Red (Critical or Emergent), Yellow (Intermediate or Delayed), Green (Minor) and Black (Deceased or Expectant). Triage designations are based on an assessment of respirations, perfusion, and mentation (RPM) that should take up to 30 seconds to perform. Triage begins by directing all ambulatory victims to move to a designated site for further evaluation. As with START, all patients who can walk are initially tagged or otherwise designated in the Green category. Note that children may be carried into the Green triage area by other ambulatory victims. These children must be triaged individually in the Green area as quickly as possible (using JS) because they have not proven their physiologic stability by walking.

Nonambulatory victims remaining in place are triaged by responders as they come to them. The next step in both the JS and START algorithms is to assess the patient for spontaneous respirations. The upper airway is positioned by the triage provider if the patient is apneic. Per START, adults who remain apneic after upper airway opening are tagged Black without a pulse check. In JS, children who remain apneic are quickly checked for the presence of a pulse because they may be in the brief stage where they still have detectable circulation. Children without a detectable pulse are tagged Black. Apneic children with a pulse receive five rescue breaths via a barrier device (not a bag-valve-mask) as a lower airway opening maneuver. The five breath ventilatory trial/lower airway opening maneuver is the “jumpstart” part of the triage tool. Some systems have chosen to waive the pulse check and give a “jumpstart” to all apneic children. Patients who begin to breathe spontaneously with the ventilatory trial are tagged Red. The triage provider moves on to the next patient without stopping to provide treatment. In some systems, triage providers carry oral airways and may use them on these Red patients to try to maintain an airway without active support. Patients who remain apneic after both upper and lower airway opening are tagged Black, as it is unlikely they will be able to continue to generate adequate circulation without ventilatory support. In small incidents with additional resources becoming quickly available such support may be possible; in large incidents or those with scant resources it will not. These patients, although not yet dead, are not expected to survive under the resource constraints of a disaster.

Children breathing at a rate of 15-45 breaths per minute are then assessed for perfusion. Those breathing faster than 45 or slower than 15 breaths per minute are tagged Red and not assessed further by the triage provider. The adult threshold for Red designation is 30 breaths per minute; therefore the combined JS/START respiratory rate thresholds are 15-30-45, easy to remember multiples of 15.
Children with acceptable respiratory rates are assessed for the presence of a pulse. Although a peripheral pulse is preferable, responders should assess whatever pulse they’re most confident in assessing. Children with no palpable pulse or a weak pulse are tagged Red and the provider moves on, pausing only to quickly attempt to control active bleeding. Mental status is assessed next in those patients with good pulses.

AVPU is the gauge of mental status used by JumpSTART. Children who have acceptable respiratory rates, good pulses and who are either Alert, responsive to Verbal stimulus, or who respond appropriately to Pain with a localizing response are tagged Yellow. Those who have good respirations and perfusion but who have an inappropriate generalized response to Pain, posturing or who are truly Unresponsive are tagged Red. Note that the threshold of appropriate vs. inappropriate response to pain corresponds to a break between levels 4 and 5 in the Motor Response portion of the Glasgow Coma Score.

Children who ordinarily can’t walk because of age, developmental delay or disability are addressed using a modification of the JS algorithm. Normally- nonambulatory children who meet Yellow criteria are quickly scanned for external signs of significant injury such as significant burns or tissue avulsions/amputations, penetrating injuries, or abdominal distention. Those with these signs remain tagged Yellow. Those without external signs of significant injury are tagged Green, even though they can’t walk.

Dr. Romig has made all JumpSTART materials available for free download from her website at www.jumpstarttriage.com. Providers are able to use and reproduce the material without explicit permission so long as it is used only for protocol and educational purposes. JumpSTART is in wide use throughout North America and is taught in many areas internationally. In 2006 it was recommended by a national advisory committee for adoption throughout Israel.\textsuperscript{7,8} JumpSTART has also been adopted by numerous hospitals for use in their Emergency Departments when disasters result in large numbers of incoming victims not already triaged on scene by EMS. A modified version of JumpSTART has also been developed for use by rescue personnel working in a hot zone where the ability to access and apply bag-valve-mask (BVM) devices may be limited.\textsuperscript{9}
3: Triage

**Smart Tape**

The Smart Tape™, designed and distributed by TSG Associates in Great Britain, is in use in New York, Connecticut, Massachusetts, Illinois and North Carolina, as well as other locations around the world. This device is also referred to as the Pediatric Triage Tape (PTT). This length-based tool defines the standard triage categories based on an MRP or RPM (Mobility/Motor, Respiratory, Perfusion/Pulse) assessment, with age-adjusted parameters in four length / age groups. The three pediatric groups are: 50–80 cm / 3–10 kg; 80–100 cm / 11–18 kg, 100–140 cm / 19–32 kg, >140 cm / >32 kg. Each compartment length / age section has a triage algorithm with vital signs corrected for age 10.

The triage approach is divided into three assessments: mental status & walking; breathing; and circulation (includes capillary refill and heart rate). The first decision point is based on mental status and mobility. If the child is alert and moving all limbs or walking they are triaged to a low priority (green); if not, the tape is opened and the assessment of breathing is performed.

If the child is not breathing, they have their airway opened, and they are still not breathing, they are considered deceased (black). If the child begins breathing after their airway is opened, they are considered highest priority (red). If the child is breathing, the respiratory rate is counted. The “normal” respiratory rates based on length / age are: 3-10 kg - 20-50 breaths per minute; 11-18 kg - 15-40 breaths per minute, 19-32 kg 10-30 breaths per minute. Over 32 kg they are assessed based on adult norms. If the respiratory rate is above or below normal bounds for age, the child is given the highest (red) priority. If the rate is within the normal bounds, capillary refill (forehead or chest) or pulse rate is assessed.

If the capillary refill is > 2 seconds then the child is given a middle level priority (yellow). If the capillary refill is < 2 seconds then the pulse rate is assessed. The “normal” pulse rates based on length / age are: 3-10 kg – 90-180 beats per minute; 11-18 kg – 80-160 beats per minute, 19-32 kg 70-140 beats per minute. Over 32 kg they are assessed based on adult norms. If the pulse rate is above or below normal bounds for age the child is given the highest (red) priority. If the rate is within the normal bounds, the child is assigned a middle priority (yellow).

The pediatric triage tape (PTT) was validated against standard trauma scoring in an emergency department setting. Three thousand four hundred sixty one children presenting to a children's hospital in Cape Town over a nine month period were triaged using the PTT. The PTT category was compared to ISS (injury severity score), NISS (New Injury Severity Score) and pediatric intervention score developed by Garner. Compared to an ISS > 15 the PTT had a sensitivity of 37.8%, specificity of 98.6%, overtriage rate of 38.8%, and an undertriage rate of 3.5%. The performance was similar comparing to the NISS and Garner criteria.

The PTT has a low sensitivity at identifying immediate priority children by these criteria, the specificity (identify non high priority patients) is excellent. The overtriage and undertriage rates are within the range deemed unavoidable by the American College of Surgeons. Additional information can be obtained from the TSG Associates website at http://www.tsgassociates.co.uk.
3: Triage

Sacco Triage Method

The Sacco Triage Method (STM) is the only MCI triage tool currently available that is based on trauma patient outcome data. Named after its originator, Dr. Bill Sacco, a renowned mathematician with extensive background in trauma scoring, the STM was derived from analysis of retrospective data from several hundred thousand US trauma registry patients of all ages.11-13 Scores derived from an RPM assessment range from 0-12, with the lower scores indicating the most critically injured and, ultimately, those with the lowest probability of survival. Age adjustments are made after the RPM assessment; infants and children gain 1-2 additional points and older patients lose 1-2 points.14 Traditional triage category color designations are not used. Instead, a proprietary software program dynamically analyzes and matches resources and patient needs to formulate a transport plan that designates which category patients are transported, in what order, where they should go and by what transport means. As additional resources become available or are saturated, the analysis can be repeated and an adjusted transport plan composed. There is also a “rule-based” version of the STM that does not require communication from the scene or software.

The Sacco Triage Method is gaining in acceptance in the US and is under scrutiny by agencies around the world. For more information, go to the Think Sharp website at http://www.sharpthinkers.com.

Limitations of Existing Disaster Triage Tools

Because of the infrequent need to use disaster triage and the difficulty of collecting accurate data in disasters, none of the existing triage tools have been clinically validated in the disaster setting. Several small studies based on drill data and simulations have suggested that START and START-like tools such as JumpSTART lack sufficient sensitivity, specificity and interrater reliability to yield significant advantage. Research is needed to determine if any of the tools currently in use are clinically valid and reliable.

Triage is a dynamic process because patient conditions and needs change over time. Most triage tools are meant to be used only in primary triage, as a gross sorting mechanism. Subsequent patient and resource assessments may result in up- or down-triaging of patients at any time. The “Secondary Assessment of Victim Endpoint” or “SAVE” method is the only standardized tool available to direct triage after more detailed secondary assessments of disaster patients have been made on-scene or at other points of care.2 SAVE has also not been clinically validated.

Finally, the currently used MCI triage tools were developed to deal with victims of conventional trauma. They are probably not adequate for use for patients of any age with potentially more diverse and complex medical conditions. Triage tools for multiple or mass casualty incidents involving medical disasters such as Hurricane Katrina and pandemic influenza, industrial disasters and the deployment of weapons of chemical, biological and radiological nature must still be developed.

Principles of Disaster Triage during Biological Events

While physical disasters are usually associated with instantaneous occurrences, such as hurricanes, building collapses, or intentional bomb blasts, biological disasters, whether naturally occurring, or human made, do not present at a single moment in time, but over an extended period. They are
also contagious in a way that even dispersible chemical and radiological agents are not. Thus, the goal of triage in biological disasters is to do the greatest good not only for the greatest number of present victims of the illness in question, but also for the greatest number of future victims of the illness – those susceptible, but not yet exposed, to the responsible infectious agent, or its vector.

The term “bioevent” has recently been applied to large scale biologically induced disasters, whether spontaneous or deliberate. Such events have the innate ability to bring about literally thousands of casualties over the course of just a few days or weeks, which would hence require emergency medical services (EMS) to provide initial triage, treatment, and transport. Moreover, due to the infectious character of most biological illnesses, factors other than acuity and severity need to be considered during triage. Most important among these are the intensity and duration of exposure to the disease vector, as well as the infectiousness of the involved microbe.

The goal of triage in bioevents, therefore, is not merely, or even primarily, the identification of victims requiring the most immediate care. Instead, it is the prevention of further transmission, as measured by the incidence of secondary infection in others, from the first point and moment of contact with the index case or cases. Indeed, by focusing on the need for acute care of disease victims, conventional triage actually impedes control of the transmission rate. For example, EMS providers who focus on immediate treatment of afflicted patients without regard for appropriate precautions, standard, airborne, or droplet, risk spreading the disease from the field into the hospital, potentially infecting scores if not hundreds of other patients and health care professionals. At the same time, failure to recognize victims in the early stages of disease, when treatment is often more effective, leads to further spread of the disease outside the hospital, hence perpetuation or prolongation of the epidemic.

Consequently, the first step in triage of patients in bioevents is to determine whether potential victims probably are, or probably are not, infected or exposed, then to assign them to specific triage categories based upon this likelihood, using a bioevent triage system such as the “SEIRV” methodology delineated in Figure 4. This requires a scripted series of questions best posed not by EMS providers, but via priority access to a telephone “hotline” or public safety (or health) answering point (PSAP), such as 911, or in some cities (such as New York), 311. Based on the onset, duration, type, and severity of symptoms, patients can then be triaged directly to specially designated inpatient facilities, outpatient clinics, points of distribution (PODs) for antibiotic medications, or home for self- or assisted-care. The U.S. Centers for Disease Control and Prevention (CDC) have called for such telephone triage systems to be used in guiding emergency transports in case of a bioevent. The CDC has also under such circumstances called for 1) plans for coordination with other transport resources in case large numbers of patients need to be transported at the height of an epidemic, 2) transport of multiple patients during a single run, and 3) use of resources other than ambulances and other vehicles designed for medical transport, such as buses.

The need for a centralized, jurisdictional Emergency Health Operations Center (EHOC) with the absolute authority to make decisions affecting the health of the population afflicted by a bioevent disaster is self evident. Here, tactical operations and training activities can be coordinated, and health systems and providers kept abreast of evolving circumstances and available resources that may require ongoing changes in triage algorithms. For example, the practice of large-scale, population-based triage necessitates establishment of both “minimum qualifications for survival” (MQS), consisting of previously determined, officially sanctioned
criteria that set forth which cases will not receive definitive care; and “exclusion criteria”, under which certain specified medical conditions would not receive the optimal resources, such as resuscitation, normally provided to such cases under the usual “inclusion criteria”. Based upon changing gaps between patients’ needs and available health care resources, both the MQS and the exclusion criteria might need to be adjusted by the EHOC, utilizing such criteria as 1) availability of critical care resources, including intensive care unit beds and mechanical ventilators, 2) acuity and severity of patient illness, categorized by standardized, validated clinical scoring methodologies, such as the Sequential Organ Failure Assessment (SOFA) score, and 3) ethical and moral standards of the community.\textsuperscript{16} Triage decisions must then be made accordingly, recognizing that the public will accept such triage, hence rationing, only if the triage criteria are honestly and transparently developed. Roles and responsibilities of the Emergency Health Operations Center (EHOC) are listed in Figure 5.\textsuperscript{17}

The success of the triage methodology applied in any large scale bioevent will be determined by a number of factors. The most important of these is a decline in the number of patients assigned to the “Susceptible” triage category, which indicates a decrease in the rate of disease transmission. A transmission rate (\(R_0\) > 1) indicates the epidemic will progress, while a transmission rate (\(R_0\) < 1) indicates that the illness will eventually disappear, especially if this is observed among vulnerable populations. By contrast, if \(R_0 = 1\), the disease will become endemic. Other factors that should be considered include decreasing mortality and morbidity associated with the epidemic, as well as appropriate resource distribution across the infected population.

In conclusion, the requirements for disaster triage in bioevents are fundamentally different than in other CBRNE events. Since the counterintuitive goal in bioevents is primarily to control secondary infections, and secondarily to control primary infections, prehospital triage systems must be optimized through centralized command and control mechanisms. This will facilitate reduction in the number of susceptible patients, thereby minimizing the burden of care among health management systems serving the afflicted population.

Summary

Although the ideal pediatric disaster triage tool probably does not yet exist, it is reasonable that having an objective pediatric-specific tool to use in multiple and mass casualty incidents will help bring order out of chaos, give those performing triage objective guidance, assure that children are given appropriate care and, hopefully, assist in maximizing survival for disaster victims of all ages.

The disaster triage tools most commonly used to meet the needs of CBRNE-injured children in the prehospital setting in the United States are JumpSTART, the Smart Tape and the Sacco Triage Method. Further research is needed to validate or modify these tools and to develop new triage tools for children in medical and industrial disasters as well as those involving weapons of mass destruction. By contrast, the disaster triage tool most commonly used to meet the needs of bioevent-infected children in the prehospital setting in the United States is SEIRV. Given the likelihood of an outbreak of pandemic influenza in the near future, EMS providers must be prepared to shift their focus to this triage tool as seamlessly as possible.
**Figure 1.** The Three “R’s” of Disaster Triage

<table>
<thead>
<tr>
<th>R</th>
<th>Resources</th>
<th>Needs outstrip the immediately available resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Relative</td>
<td>Local resource constraints define a disaster</td>
</tr>
<tr>
<td>R</td>
<td>Rational</td>
<td>Triage should be based on rational, objective decisions</td>
</tr>
</tbody>
</table>
**Figure 2.** Triage tool modifications for children

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>DIFFERENCES</th>
<th>CHANGES TO TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Airway</strong></td>
<td>Airway is vulnerable to obstruction. Apnea due to obstruction may be reversible if caught quickly.</td>
<td>Prioritize airway opening maneuver(s)</td>
</tr>
<tr>
<td><strong>Breathing</strong></td>
<td>Normal respiratory rate range is higher</td>
<td>Alter respiratory rate thresholds</td>
</tr>
<tr>
<td></td>
<td>Slow breathing is more ominous than tachypnea</td>
<td>Include low respiratory rate threshold</td>
</tr>
<tr>
<td><strong>Circulation</strong></td>
<td>Normal heart rate range is higher</td>
<td>Alter heart rate thresholds</td>
</tr>
<tr>
<td></td>
<td>Vulnerable to cool environments</td>
<td>Capillary refill may be unreliable</td>
</tr>
<tr>
<td></td>
<td>Difficult and time consuming to obtain accurate blood pressure</td>
<td>Don’t use BP as an assessment parameter</td>
</tr>
<tr>
<td></td>
<td>Heart dies after a period of anoxia. Circulation may be sustained for a brief time before the heart is irreversibly damaged</td>
<td>Check for circulation in an apneic child</td>
</tr>
<tr>
<td><strong>Neuro</strong></td>
<td>Ability to verbalize and obey commands varies with age</td>
<td>Use Best Motor Score</td>
</tr>
<tr>
<td></td>
<td>Ability to ambulate is developmentally dependent</td>
<td>Don’t use the ability to walk as the only determinant of nonurgent status</td>
</tr>
</tbody>
</table>
Figure 3. The JumpSTART Pediatric MCI Triage Tool (used with permission)

JumpSTART Pediatric MCI Triage

Able to walk?
- YES: MINOR
- NO: Secondary Triage*

Breathing?
- NO: Position upper airway
  - BREATHING: IMMEDIATE
  - APNEIC: DECEASED
- YES: Palpable pulse?
  - NO: DECEASED
  - YES: 5 rescue breaths
    - APNEIC: DECEASED
    - BREATHING: IMMEDIATE

Respiratory Rate
- <15 OR >45: IMMEDIATE
- 15-45
  - Palpable Pulse?
    - NO: IMMEDIATE
    - YES: AVPU
      - "P" (INAPPROPRIATE) POSTURING OR "U": IMMEDIATE
      - "A", "V" OR "P" (APPROPRIATE): DELAYED

* Evaluate infants first in secondary triage using the entire JS algorithm.
**Figure 4.** “SEIRV” bioevent triage methodology

- Susceptible but not exposed
- Exposed but not infected
- Infected
- Removed by death or recovery
- Vaccinated or protected by medication
Figure 5. Roles and responsibilities of the Emergency Health Operations Center (EHOC)

- Situational awareness
- Link regional resources
- Develop and maintain strategic alliances
- Facilitate and integrate resources
- Communicate and reinforce
- Triage resources and decisions
- Just-in-time training
- Measures of effectiveness
References


5. SALT Triage. [Confirm reference.]


**Other resources:**


JumpSTART [www.jumpstarttriage.com](http://www.jumpstarttriage.com)

Smart Tape [www.tgaassociates.co.uk](http://www.tgaassociates.co.uk)

Sacco Triage Method [www.sharpthinkers.com](http://www.sharpthinkers.com)
Chapter 4: Prehospital Disaster Medical Systems

Arthur Cooper, MD

Introduction

Patient care, both in the field and in the hospital, is normally delivered to one individual patient at a time by health care providers working as individuals or in one or more teams. Prehospital professionals are accustomed to rendering emergency care in this manner as a routine, at the scene and during transport, and typically do so independent of the direct involvement of other public health or safety professionals. By contrast, patient care in disasters is delivered to multiple patients by limited numbers of health care providers organized as small medical response teams. This requires collaboration with other public health and safety professionals, hence a coordinated incident management system (IMS).

Hospital-based health care providers take such organization for granted: for every allied health professional, nurse, or physician, there are numerous other hospital employees whose task it is to make sure patients have the facilities, resources, and staff they need to ensure a speedy recovery from illness or injury, and that the individuals providing health care have the tools required to care for patients when and where they need them. While emergency medical services (EMS) agencies also require administrative and operational support, few such agencies approach the complexity of modern hospital organizations. However, in true disasters, EMS agencies must do exactly what hospitals routinely do: bring to bear myriad healthcare resources to the aid of numerous patients more or less simultaneously, with efficiency and economy of effort, lest any salvageable life be lost. It is the purpose of this chapter to describe the incident management system (IMS) in common use in the United States, how EMS personnel ideally work within it, and the Federal assets that can be brought to bear to assist in a Presidentially declared disaster.

National Incident Management System (NIMS)

Prehospital disaster medical systems in the United States are based on the National Incident Management System (NIMS). This was mandated by Homeland Security Presidential Directive/HSPD-5, Subject: Management of Domestic Incidents, issued by President George W. Bush on February 28, 2003, which under Sections (1), (3), and (15) duly established the following as the official course of action of the United States Government, and which as a Presidential Directive remains legally in force until such time as duly rescinded by the President himself, or his successor in that office:

Purpose

(1) To enhance the ability of the United States to manage domestic incidents by establishing a single, comprehensive national incident management system. . . .

Policy

(3) To prevent, prepare for, respond to, and recover from terrorist attacks, major disasters, and other emergencies, the United States Government shall establish a single, comprehensive approach to domestic incident management. The objective of the United States Government is to ensure that all levels of government across the Nation have the capability to work
efficiently and effectively together, using a national approach to domestic incident management. In these efforts, with regard to domestic incidents, the United States Government treats crisis management and consequence management as a single, integrated function, rather than as two separate functions.

Tasking

(15) The Secretary [of Homeland Security] shall develop, submit for review to the Homeland Security Council, and administer a National Incident Management System (NIMS). The system will provide a consistent nationwide approach for Federal, State, and local governments to work effectively and efficiently together to prepare for, respond to, and recover from domestic incidents, regardless of cause, size, or complexity. To provide for interoperability and compatibility among Federal, State, and local capabilities, the NIMS will include a core set of concepts, principles, terminology, and technologies covering the incident command system; multi-agency coordination systems; unified command; training; identification and management of resources (including systems for classifying types of resources); qualifications and certification; and the collection, tracking, and reporting of incident information and incident resources.

This single, comprehensive approach to the management of terror events and disasters is known as the “all hazards” approach, because it utilizes a single national framework for incident response regardless of the type of incident being managed, with branch points in the response protocol that address specific concerns related to the actual type of incident, whether Chemical, Biological, Radioactive, Nuclear, or Explosive/Incendiary (CBRNE). The benefits of adopting the NIMS in terms of coordinated – therefore effective – action by all personnel and agencies responding to a terror event or a disaster are self evident.

The intent of NIMS is to “provide a framework for interoperability and compatibility by balancing flexibility and standardization.” Its “flexible framework … facilitates government and private entities at all levels working together …” Its “standardized organizational structures … improve operability.” The components of NIMS, as defined by the Secretary of Homeland Security, include the following six elements, each of which will be addressed in further detail in the sections that follow the list below, in language quoted directly from the IS-700 NIMS Course Summary to avoid confusion:

• Command and management
• Preparedness
• Resource management
• Communications and incident management
• Supporting technologies
• Ongoing management and maintenance

Command and Management

"NIMS incident management structures are comprised of three important systems:

• The Incident Command System (ICS), which defines the operating characteristics, management components, and structure of incident management organizations throughout the life cycle of an incident."
• Multiagency Coordination Systems, which define the operating characteristics management components, and organizational structure of supporting entities.

• Public Information Systems, which include the processes, procedures, and systems for communicating timely and accurate information to the public during emergency situations.

**Preparedness**

“Effective incident management begins with a host of preparedness activities. These activities are conducted on a ‘steady-state’ basis, as well as in advance of any potential incident. Preparedness involves a combination of:

• Planning, training, and exercises.
• Personnel qualification and equipment standards.
• Equipment acquisition and certification standards.
• Publication management processes and activities.
• Mutual aid agreements and Emergency Management Assistance Compacts.

**Resource Management**

“When fully implemented, NIMS will define standardized mechanisms and establish requirements for describing, inventorying, mobilizing, dispatching, tracking, and recovering resources over the life cycle of an incident.

**Communications and Information Management**

“NIMS identifies the requirements for a standardized framework for communications, information management, and information-sharing support at all levels of incident management.

• Incident management organizations must ensure that effective, interoperable communications processes, procedures, and systems exist across all agencies and jurisdictions.
• Information management systems help ensure that information flows efficiently through a commonly accepted architecture. Effective information management enhances incident management and response by helping to ensure that decision-making is better informed.

**Supporting Technologies**

“Technology and technological systems provide supporting capabilities essential to implementing and refining NIMS. Examples include:

• Voice and data communication systems.
• Information management systems, such as recordkeeping and resource tracking.
• Data display systems.
“Supporting technologies also include specialized technologies that facilitate ongoing operations and incident management activities in situations that call for unique technology-based capabilities.

**Ongoing Management and Maintenance**

“DHS established the NIMS Integration Center to provide strategic direction and oversight in support of routine review and continual refinement of both the system and its components over the long term.”

**National Response Framework (NRF)**

The *National Response Framework* (NRF), approved by the President on January 8, 2008, replaces the *National Response Plan* (NRP) called for in HSPD-5, which was viewed by many as both too prescriptive and detailed to be useful in a disaster response, and insufficiently cognizant of the role of private and nongovernmental organizations.3 The NRF, again quoting directly from the *IS-800.B NRF Course Overview*, "presents the guiding principles that enable all response partners to prepare for and provide a unified national response to disasters and emergencies – from the smallest incident to the largest catastrophe.4 Building on the National Incident Management System, the Framework’s coordinating structures align key roles and responsibilities fostering response partnerships at all levels of government, and with nongovernmental organizations and the private sector. Given its flexibility and scalability, the National Response Framework is always in effect and elements can be implemented at any level and at any time.

“The Framework establishes a response vision through five key principles….4” These key principles are known as **response doctrines**. “Response doctrine defines basic roles, responsibilities, and operational concepts for response across all levels of government and with the private sector and nongovernmental organizations. It is important to remember that the overarching objective of response activities is life safety, followed by protecting property and the environment.”5

**Engaged partnership** – “Leaders at all levels [must] develop shared response goals and align capabilities so that no one is overwhelmed in times of crisis.

**Tiered response** – “Incident must be managed at the lowest possible jurisdictional level and supported by additional capabilities when needed.

**Scalable, flexible, and adaptable operational capabilities** – “As incidents change in size, scope, and complexity, the response must adapt to meet requirements.

**Unity of effort through unified command** – “Unity of effort respects the chain of command of each participating organization while harnessing seamless coordination across jurisdictions in support of common objectives.

**Readiness to act** – “It is our collective duty to provide the best response possible. From individuals, households, and communities to local, tribal, State, and Federal governments, national response depends on our readiness to act.
“The National Response Framework strives to improved coordination among all response partners. And through these partnerships, [Americans] can work together to help save lives and protect [its] communities.”

Engaged Partnership

“Effective response activities begin with a host of preparedness activities conducted well in advance of an incident. Preparedness involves a combination of planning, resources, training, exercising, and organizing to build, sustain, and improve operational capabilities. **Key Concept: Engaged partnerships are essential to preparedness. . . .**

Tiered Response

“Incidents begin and end locally, and most are managed at the local level. Many incidents require unified response from local agencies, the private sector, and nongovernmental organizations. Other incidents may require additional support from neighboring jurisdictions or the State. A small number require Federal support. National response protocols recognize this and are structured to provide additional, tiered levels of support. **Key Concept: A basic premise of the Framework is that incidents are generally handled at the lowest jurisdictional level possible. . . .**

Scalable, Flexible, and Adaptable Operational Capabilities

“The number, type, and sources of resources must be able to expand rapidly to meet the needs associated with a given incident. The Framework builds on the National Incident Management System (NIMS). Together, the Framework and NIMS help to ensure that all response partners use standard command and management structures that allow for scalable, flexible, and adaptable operational capabilities. . . . **Key Concept: As incidents change in size, scope, and complexity, the response must adapt to meet these requirements.**

Unity of Effort Through Unified Command

Success requires unity of effort, which respects the chain of command of each participating organization while harnessing seamless coordination across jurisdictions in support of common objectives. As a team effort, unified command allows all agencies with jurisdictional authority and/or functional responsibility for the incident to provide joint support through mutually developed incident objectives and strategies. Each participating agency maintains its own authority, responsibility, and accountability. . . .”

**Key Concept: “Unified command benefits include a collective, strategic approach; joint priorities and resource allocation; single plan and set of objectives; improved information flow and coordination. . . .**

Readiness To Act

A forward-leaning posture is imperative for incidents that have the potential to expand rapidly in size, scope, or complexity, or for no-notice incidents. Once response activities have begun, on-scene actions are based on NIMS principles. An effective national response relies on disciplined processes, procedures, and systems. **Key Concept: Readiness to act is a**
collective responsibility. Effective national response depends on our readiness to act.

National Response Framework Organization

“The National Response Framework is comprised of the core document, the Emergency Support Function (ESF), Support, and Incident Annexes, and the Partner Guides. The core document describes the doctrine that guides our national response, roles and responsibilities, response actions, response organizations, and planning requirements to achieve an effective national response to any incident that occurs.”

National Response Framework Components

“Core Document:” The core document presents:

- An **Introduction** to the doctrine that guides our national response.
- **Roles and Responsibilities** including who is involved with emergency management activities at the local, tribal, State, and Federal levels and with the private sector and nongovernmental organizations.
- **Response Actions** that describe what we as a Nation collectively do to respond to incidents.
- **Response Organization** specifying how we as a Nation are organized to implement response actions.
- **Planning** requirements to achieve an effective national response to any incident that occurs.

“Annexes:” “The following documents provide more detailed information in assist practitioners in implementing the Framework:

- **Emergency Support Function Annexes** group Federal resources and capabilities into functional areas that are most frequently needed in a national response (e.g., Transportation, Firefighting, Search and Rescue, Mass Care).
- **Support Annexes** describe essential supporting aspects that are common to all incidents (e.g., Financial Management, Volunteer and Donations Management, Private-Sector Coordination). The actions described in the Support Annexes are not limited to particular types of events, but are overarching in nature and applicable to nearly every type of incident. In addition, they may support several ESFs.
- **Incident Annexes** address unique aspects of how we respond to seven broad incident categories (e.g., Biological, Nuclear/Radiological, Cyber, Mass Evacuation). The overarching nature of functions described in these annexes frequently involves either support to or cooperation of all Federal departments and agencies involved in incident management efforts to ensure seamless integration of and transitions between preparedness, prevention, response, recovery, and mitigation activities.
- **Partner Guides** provide ready references describing key roles and actions for local, tribal, State, Federal, and private-sector response partners.”

“These documents are available at the NRF Resource Center, [http://www.fema.gov/nrf].”

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**Emergency Support Function (ESF) #8 – Public Health and Medical Services**

EMS personnel and agencies responding to a terror event or disaster are considered part of *Emergency Support Function* (ESF) #8, as described in the *National Response Framework* (NRF). It is paramount that all EMS personnel and agencies responding to a terror event or disaster do so as part of an organized response. The duly designated lead public safety or health agency will be in charge of mobilizing support agencies as needed. Again quoting directly from the *IS-808 ESF#8 Course Summary* for purposes of clarity:

**Emergency Support Functions (ESFs) Review**

“Coordination of Federal incident response is accomplished through the ESF framework. ESFs are organized groups of government and private-sector entities that provide personnel, supplies, facilities, and equipment. Each ESF is comprised of:

- **Primary Agencies:** The National Response Plan identifies primary agencies on the basis of authorities, resources, and capabilities.

- **Support Agencies:** Support agencies are assigned based on resources and capabilities in a given functional area.

ESFs may be selectively activated based on the threat, event, or incident. ESF resources may be assigned to serve within any of the response organizations.

**ESF #8: Purpose**

“Emergency Support Function (ESF) #8 – Public Health and Medical Services provides the mechanism for coordinated Federal assistance to supplement State, tribal, and local resources in response to a potential or actual:

- Public health and medical disaster or emergency (e.g., pandemic flu outbreak, bioterrorism attack).
- Natural disaster (e.g., hurricane, earthquake, flood).

Public Health and Medical Services include behavioral health needs of incident victims and response workers, additional medical response assistance for medical needs populations, and veterinary and/or animal health issues.

**ESF #8: Coordinator and Primary Agency**

“The Department of Health and Human Services (HHS) is the ESF #8 coordinator and primary agency. . . .”

**ESF #8: Support Agencies**

Numerous Federal agencies serve in a supportive capacity.

**ESF #8: Actions**

“Federal assistance to supplement State, tribal, and local resources may include:
• **Public Health & Medical Needs Assessment** – HHS, in collaboration with the Department of Homeland Security (DHS), mobilizes and deploys ESF #8 personnel to support national or regional teams to assess public health and medical needs. These assessments may include: Language assistance services for individuals with limited English proficiency; Accommodations and services for individuals with disabilities; Health care system or facility infrastructure.

• **Public Health Surveillance** – HHS, in coordination with supporting departments and agencies: Enhances existing surveillance systems to monitor the health of the general population and special needs populations; Carries out field studies and investigations; Monitors injury and disease patterns, potential disease outbreaks, blood and blood product (e.g., plasma) safety, and blood supply levels.

• **Medical Care Personnel Deployment** – Immediate medical response capabilities are provided by: HHS assets; ESF #8 supporting organizations; Civilian volunteers. The role of these medical care personnel is to assist State, tribal, and local public health and medical personnel. HHS assets include: The U.S. Public Health Service Commissioned Corps; The National Disaster Medical System (NDMS).

• **Medical Equipment & Supplies Distribution** – ESF #8 may request the Department of Defense (DOD) or the Department of Veterans Affairs (VA) to provide medical equipment and supplies in support of immediate medical response operations and for restocking health care facilities in an area affected by a major disaster or emergency. ESF #8 may also deploy assets from the Strategic National Stockpile (SNS). When a veterinary response is required, assets may be requested from the National Veterinary Stockpile, which is managed by the USDA [United States Department of Agriculture] Animal and Plant Health Investigation Service (APHIS).

• **Patient Evacuation and Care** – ESF #8 is responsible for transporting seriously ill (seriously ill describes persons whose illness or injury is of such severity that there is cause for immediate concern, but there is not imminent danger to life) or injured patients, and medical needs populations, from a casualty collection point (CCP) in the impacted area to designated reception facilities. Note that the State is responsible for gathering patients at CCPs. Once at the CCP, ESF #8 is then responsible for patient evacuation. The Department of Defense (DOD) is the only recognized Federal partner responsible for regulating and tracking patients transported on DOD assets to appropriate treatment facilities (e.g., National Disaster Medical System (NDMS) hospitals). ESF #8 may task HHS components to engage civil service personnel, Officers from the U.S. Public Health Commissioned Corps, the regional offices, and States to engage civilian volunteers and request the Department of Veterans Affairs (VA) and the Department of Defense (DOD) to provide available personnel to support prehospital triage and treatment, inpatient hospital care, outpatient services, pharmacy services, and dental care to victims who are seriously ill, injured, or suffer from chronic illnesses who need evacuation assistance, regardless of location. ESF #8 may assist with isolation and quarantine measures and with point of distribution operations (mass prophylaxis and vaccination). Health care and support staff providers will ensure appropriate patient confidentiality is maintained, including Health Insurance Portability and Accountability Act [HIPAA] privacy and security standards, where applicable.
ESF #8: Other Actions

“Below are examples of other ESF #8 actions:

- Safety and Security
- Blood, Organs, and Blood Tissues
- Behavioral Health Care
- Public Health and Medical Information
- Vector Control
- Public Health Aspects of Potable Water/Wastewater and Solid Waste
- Mass Fatality Management
- Veterinary Medical Support

A detailed discussion of these actions is beyond the scope of this chapter.

ESF #8: Specialized Resources and Capabilities

“ESF #8 also coordinates numerous specialized resources and capabilities, [including] the National Disaster Medical System (NDMS). NDMS provides a single, integrated national medical response capability for assisting State and local authorities in responding to: Natural disasters; Major transportation accidents; Acts of terrorism including weapons of mass destruction [WMD] events. The NDMS teams are staffed by agency personnel and private citizens with specialized training and expertise. These teams are activated as needed during disasters or other events to provide: Medical care, including specialized treatment like crush injuries or burn treatment; Patient movement from a disaster site to unaffected areas of the Nation; Victim identification and mortuary services; Veterinary services for animals affected by an incident.

“ESF #8 may also coordinate the deployment of assets from the Strategic National Stockpile (SNS). The stockpile has large quantities of medicine and medical supplies to protect the American public in an incident severe enough to cause local supplies to run out. Push Packages are caches of pharmaceuticals, antidotes, and medical supplies designed to provide rapid delivery. These Push Packages are positioned in strategically located, secure warehouses for delivery within 12 hours. Each State has plans to receive and distribute the medicines and medical supplies to local communities as quickly as possible, including providing adequate staffing of dispensing sites or treatment centers, and managing the inventory. . . .

“NDMS includes the following teams: Disaster Medical Assistance Teams (DMATs) [of which there are ] standard DMATs [and] highly specialized DMATs, including four burn teams, two pediatric teams, one crush medicine team, and three international medical/surgical teams; National Medical Response Teams (NMRTs); Disaster Mortuary Operational Response Teams (DMORTs); Family Assistance Center Teams; Mental Health Teams; National Veterinary Response Teams (NVRTs); National Nurse Response Teams (NNRTs); National Pharmacy Response Teams (NPRTs). . . .
“The U.S. Public Health Service Commissioned Corps, a uniformed service led by the Surgeon General, includes the following teams, or team support: Incident Response Coordination Team (IRCT); Applied Public Health Team (APHT), [which] can be described as a ‘public health department in a box’; Mental Health Teams (MHTs); Rapid Deployment Force (RDF). . . comprised of 105 U.S. Public Health Service Commissioned Corps Officers . . . [whose] capabilities include [provision of public health measure of immediate and critical importance to the health of the public].

**ESF #8: Concept of Operations**

“Once a decision has been made to activate ESF #8 assets, staff are alerted and deployed. The initial activities are to:

- Conduct a risk analysis, evaluate, and determine the capability required to meet the mission objective.
- Provide required public health and medical support medical assistance to State, tribal, and local medical and public health officials.

“In the early stages of an incident, it may not be possible to fully assess the situation and verify the level of assistance required. In such circumstances, HHS may provide assistance under its own statutory authorities. In these cases, every reasonable attempt is made to verify the need before providing assistance.  

Any request for Federal assistance must follow upon a Presidential disaster declaration, in accordance with the provisions of the Stafford Act, since unilateral Federal action in a State is prohibited by the Posse Comitatus Act. Such declaration can only be made upon request of the Governor(s) of the involved State(s). Before requesting Federal aid, the Governor(s) of the involved State(s) must already have made a disaster declaration. The President can then direct the Secretary of Health and Human Services to activate ESF #8, which under the Pandemic and All Hazards Preparedness Act (PAHPA), is the responsibility of the Assistant Secretary for Preparedness and Response (ASPR).

**Incident Command System (ICS)**

The Incident Command System (ICS) now in common use in the United States resulted from the experiences of those battling California wildfires in the 1970s and 1980s. To contain these fires, the services of numerous agencies from several states were required – but the involved agencies unfortunately used different command structures as well as radio frequencies, making it difficult, and in many cases impossible, to communicate between agencies. As a result, the lives of several firefighters were unnecessarily lost, leading experts in firematics to partner with those in management to develop a universal system for incident command built on the principles of Management by Objectives and Results – a system recently adopted and endorsed by the Department of Homeland Security (DHS) as a fundamental component of the National Incident Management System (NIMS) and the National Response Framework (NRF), and taught in all its training courses (Table 1). The Incident Command System (ICS) now in place employs four Staff Officers as part of its Command Staff, Liaison, Medical/Technical, Public Information, and Safety, easily remembered by the mnemonic, “[Mount] OLMPS”; and four Section Chiefs to comprise its
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**Pediatric Disaster Preparedness**

General Staff, Finance/Administration, Logistics, Operations, and Planning, easily remembered by the mnemonic, “C-FLOP” (Figure 1A).

In addition, the Incident Command System (ICS) now in place is based on the principle of *Unity of Command* – the premise that, while informal sharing of information is strongly encouraged at every level of the Incident Command Structure, formal briefings, orders, and reports flow from, to, or through only a single supervisor, whose *Span of Control* does not exceed three to seven, and ideally only five, subordinates. While Incident Command may be shared by designated officers of multiple agencies with primary jurisdictional authority and responsibility, one of whom will act as the spokesperson – a structure known as *Unified Incident Command* – all participating agencies and personnel, even though their focus will be to provide an effective disaster response within their individual areas of expertise, agree to report via various Section Chiefs to a single locus of Incident Command, supported by Staff Officers who assist Incident Command with certain command functions. The implementation and operation of this Incident Command System should be well known to EMS leaders making use of this resource, and thus will be summarized diagrammatically rather than explained in detail (Figure 1B). Suffice it to say that 1) under all the but most unusual circumstances, EMS will serve as a support rather than a command agency, and confine its operations to triage, treatment, and transport of the acutely ill and injured, and 2) the provision of pediatric emergency care must be the responsibility of all involved EMS agencies and personnel, since children requiring such care will be encountered in all disaster venues.

As stated by the United States Department of Homeland Security in the *IS-700 Course Summary*, “The Incident Command System (ICS) is a standard, on-scene, all-hazard incident management system. The ICS allows users to adopt an integrated organizational structure to match the needs of single or multiple incidents. . . . ICS is a proven system that is used widely for incident management by firefighters, rescuers, emergency medical teams, and hazardous materials teams. ICS represents organizational ‘best practices’ and has become the standard for incident management across the country.”

In addition, the United States Department of Homeland Security states that, “ICS is interdisciplinary and organizationally flexible to meet the needs of incidents of any kind, size, or level of complexity. Using ICS, personnel from a variety of agencies can meld rapidly into a common management structure. ICS has been tested for more than 30 years and used for: Planned events; Fires, hazardous materials spills, and multicasualty incidents; Multi-jurisdictional and multi-agency disasters, such as earthquakes and winter storms; Search and rescue missions; Biological outbreaks and disease containment; Acts of terrorism. ICS helps all responders communicate and get what they need when they need it. ICS provides a safe, efficient, and cost-effective recovery strategy.

**ICS Features**

“ICS has several features that make it well suited to managing incidents. These include:

- Common terminology [including use of ‘clear text’ in lieu of agency-specific codes].
- Organizational resources [including use of common designations for resource type].
- Manageable span of control [described above].
- Organizational facilities [including use of common terminology for similar facilities].
- Use of position titles [to reduce confusion between day-to-day and disaster positions].

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• Reliance on an Incident Action Plan [to effectively communicate disaster objectives].
• Integrated communications [to ensure that information is accurately transmitted].
• Accountability [to ensure that all personnel act as a part of the incident response].

“In some situations, NIMS recommends variations in incident management. The two most common variations involve the use of Unified Command and Area Command.

Unified Command

“Unified Command is an application of ICS used when: There is more than one responding agency with responsibility for the incident; Incidents cross political jurisdictions (Figure 2A). Under a Unified Command, agencies work together through the designated members of the Unified Command to: Analyze intelligence information; Establish a common set of objectives and strategies for a single Incident Action Plan [IAP]. Unified Command does not change any other features of ICS. It merely allows all agencies with responsibility for the incident to participate in the decision-making process.

Area Command

“Area Command is an organization established to: Oversee the management of multiple incidents that are each being managed by and ICS organization; Oversee the management of large incidents that cross jurisdictional boundaries (Figure 2B). Area Commands are particularly relevant to public health emergencies because these incidents are typically: Not site specific; Not immediately identifiable; Geographically dispersed and evolve over time. . . . The Area Command has the responsibility for: Setting overall strategy and priorities; Allocating critical resources according to the priorities; Ensuring that incidents are properly managed; Ensuring that objectives are met; Ensuring that strategies are followed. . . . An Area Command is organized similarly to an ICS structure but, because operations are conducted on-scene, there is no Operations Section in an Area Command [although] other Sections and functions are represented in [its] structure.

Multidisciplinary Coordination Systems

“Multi-agency Coordination Systems are a combination of facilities, equipment, personnel, procedures, and communications integrated into a common framework for coordinating and supporting incident management [in expanding and complex incidents that require higher-level resource management or information management]. . . . The primary functions of Multi-agency Coordination Systems are to: Support incident management policies and priorities; Facilitate logistics support and resource tracking; Make resource allocation decisions based on incident management priorities; Coordinate incident-related information; Coordinate interagency and intergovernmental issues regarding incident management policies, priorities, and strategies. Direct tactical and operational responsibility for the conduct of incident management activities rests with the on-scene Incident Commander. Multi-agency Coordination Systems include Emergency Operations Centers (EOCs), the locations from which the coordination of information and resources to support incident activities takes place, [and] which are typically established by the emergency management agency at the local and State levels; and, in certain multi-jurisdictional or complex incidents, Multi-agency Coordination Entities, [which] typically consist of principals from organizations with direct incident management responsibilities or significant incident management support or
resource responsibilities, [and which] may be used to facilitate incident management and policy coordination.

**Emergency Operations Centers (EOCs)**

“EOC organization and staffing is flexible, but should include: Coordination; Communications; Resource dispatching and tracking; Information collection, analysis, and dissemination. EOCs may be staffed by personnel representing multiple jurisdictions and functional disciplines. The size, staffing, and equipment at an EOC will depend on the size of the jurisdiction, the resources available, and the anticipated incident needs. EOCs may also support multi-agency coordination and joint information activities.

**Multidisciplinary Coordination Entities**

“Regardless of their form or structure, Multi-agency Coordination Entities are responsible for: Ensuring that each involved agency is providing situation and resource status information; Establishing priorities between incidents and/or Area Commands in concert with the Incident Command or Unified Command; Acquiring and allocating resources required by incident management personnel; Coordinating and identifying future resource requirements; Coordinating and resolving policy issues; Providing strategic coordination. [During the recovery phase] following incidents, Multi-agency Coordination Entities are typically responsible for ensuring that [necessary] revisions are acted upon. Revisions may be made to: Plans; Procedures; Communications; Staffing; Other capabilities necessary for improved incident management. These revisions are based on lessons learned from the incident [as recorded in verbal or written After Action Reports]. They should be coordinated with the emergency planning team in the [involved] jurisdiction and with mutual aid partners [in adjacent involved jurisdictions].”

**Incident Action Planning**

The creation and implementation of an Incident Action Plan (IAP) are the fundamental task of any Incident Command System (ICS), regardless of the structure utilized. The planning cycle used by Incident Command is well established (Figure 3). It begins with notification of a potential event, which is followed immediately by the Initial Response and Threat Assessment. Once these are underway and completed, an Initial Incident Briefing is held, after which Incident Command – ideally Unified Incident Command – first meets, determines its strategic objectives, and develops the Incident Action Plan.

The cycle repeats itself through each Operational Period. Each new Operational Period begins with a briefing, facilitated by the Planning Section Chief, during which the outgoing Operations Section Chief summarizes the current incident status. After review of other relevant issues, including conditions affecting the safety of incident responders, the incoming Operations Section Chief outlines tactical objectives for the new Operational Period. Review of strategic goals by Incident Command ends the meeting.

**Public Information**

“Because public information is critical to domestic incident management, it is imperative to establish Public Information Systems and protocols for communicating timely and accurate
information to the public during emergency situations. Under NIMS, the PIO [Public Information Officer] is a key member of the [ICS] command staff. The PIO advises the Incident Command on all public information matters related to the management of the incident, including media and public inquiries, emergency public information and warnings, rumor monitoring and control, media monitoring, and other functions required to coordinate, clear with proper authorities, and disseminate accurate and timely information related to the incident. The PIO establishes and operates within the parameters established for the Joint Information System (JIS), [which] provides an organized, integrated, and coordinated mechanism for providing information to the public during an emergency, including plans, protocols, and structures used to provide information to the public, and encompassing all public information related to the incident.

"Key elements of a JIS include interagency coordination and integration, developing and delivering coordinated messages, and support for decision-makers. The PIO, using the JIS, ensures that decision-makers – and the public – are fully informed throughout a domestic incident response. During emergencies, the public may receive information from a variety of sources; part of the PIO’s job is ensuring that the information that the public receives is accurate, coordinated, timely, and easy to understand. One way to ensure the coordination of public information is by establishing a Joint Information Center (JIC); using the JIC as a central location, information can be coordinated and integrated across [all involved] jurisdictions and agencies, and among all [involved] government partners, the private sector, and nongovernmental agencies. . . ."2

Summary

Prehospital disaster medical systems range from simple organizations that manage single incidents with limited numbers of patients, to complex multi-agency, multi-jurisdictional organizations that manage expanding or complicated incidents involving large numbers of victims. In the United States, the National Incident Management System (NIMS) – through the National Response Framework (NRF) – provides a flexible, scalable, and readily adaptable system designed to address all hazards appropriately and consistently. This chapter provides a brief overview of this ideal system. However, it is incumbent upon all EMS providers to make this system a reality within their own agencies, through education and training, as well as constant drilling in its application to medical disasters.

Although the purpose of this Resource is to focus upon the needs of children in disasters, disasters do not separate cleanly into those involving children and those involving adults. As such, children are best served by disaster systems that ensure their special needs are met at every level of system organization. The other chapters in this Resource will provide valuable insight into how these special needs are ideally met. However, absent an organized system within which state-of-the-art pediatric care can be provided, children will fare poorly in the medical response to disasters – an outcome America can ill afford.

References


### Table 1. Department of Homeland Security ICS and EMS Courses*

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<tr>
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<th>Title</th>
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<tbody>
<tr>
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<td>Introduction to Incident Command Systems</td>
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<td>IS-200</td>
<td>ICS for Single Resources and Initial Action Incidents</td>
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<td>IS-300</td>
<td>Intermediate ICS for Expanding Incidents</td>
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</tr>
<tr>
<td>PER-212</td>
<td>WMD/Terrorist Incident Defensive Operations for First Responders</td>
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Figure 1. Incident Command System in Common Use in the United States

A. Structure*

*Source: Center for Domestic Preparedness, Anniston, AL

B. Function†

†Source: Center for Domestic Preparedness, Anniston, AL
Figure 2. Variations in Incident Command Systems

A. Unified Command*

*Source: Center for Domestic Preparedness, Anniston, AL

B. Area Command†

†Source: Center for Domestic Preparedness, Anniston, AL
Figure 3. Incident Command System (ICS) Planning “P”*

*Source: Center for Domestic Preparedness, Anniston, AL
Chapter 5: Pediatric Regional Triage & Transport

Robert Kanter MD

Introduction

Pediatric non-disaster regional needs & resources

Severely ill or injured children typically are referred to a pediatric hospital after prehospital and emergency department (ED) stabilization. Those hospitalized with mild low-risk conditions are often admitted near home at a non-pediatric hospital. For complex, high-risk pediatric conditions, outcomes tend to be better at high volume hospitals offering comprehensive pediatric services. Fewer pediatric than adult patients have complex high-risk conditions. Thus the highest level of comprehensive pediatric emergency and hospital services tend to be clustered at a few pediatric hospitals that may be widely separated. As a result pediatric and adult regions differ when defined by referral patterns. In routine non-disaster circumstances, decisions about the distribution of patients to hospitals are only partly determined by medical criteria. Hospital preferences of providers and families are sometimes based on familiarity and convenience. In the US, health care services are typically privately owned and operated. Thus payers and business affiliations of health care organizations also influence hospital choice.

Regional disaster triage

In disasters involving substantial numbers of pediatric patients, the needs of a disaster surge will quickly exhaust the capacity of individual facilities for children. Effective use of resources across an entire region will be essential to serve large patient surges in a disaster. It may be necessary to maximize outcomes for populations across a region instead of maximizing individual care.

In this chapter, disaster triage will be considered on a regional basis. Evidence regarding pediatric regional disaster needs and resources will be described. In the process of regional triage, patients needing specified levels of intervention are matched with available facilities. Efficient use of inpatient resources is important in accommodating new disaster patients into EDs. In large disasters, private and public services must be integrated. Regional disaster triage requires up-to-date information about needs and vacant available capacity, authority to coordinate responses, and the ability to transport patients. One definition of a region is the geographical area covered by decision-making authority. In this regard, pediatric and adult health service regions are identical.

Pediatric Regional Needs in Disasters

All-hazard and event-specific estimates

An almost infinite range of potential disasters can be imagined. Since it is impossible to prepare specifically for every contingency, most authorities recommend all-hazard planning, with additional preparation for specific needs. The Table identifies representative disasters
including terrorism, accidents, natural disasters, and natural diseases. The table describes major care needs associated with each.

**Severe patients**

Current federal guidelines call for hospitals to rapidly accommodate surges of 500 inpatients per million population with infections, and 50 inpatients per million population in other mass casualty events. This target for mass casualty events is lower than previous guidelines of 500 per million population for any type of mass casualty event, but no model or methodology has been published to justify target levels. In trauma intensive disasters, approximately 15% of casualties need immediate care in order to survive. In previous mass casualty events up to 30% of survivors who were hospitalized needed a high level of care warranting intensive care unit (ICU) admission.

**Less severe patients**

In addition to those requiring hospitalization, much larger numbers would require outpatient emergency treatment. Surveillance following two recent hurricanes indicated that for every individual needing hospitalization, approximately nine were treated as outpatients for acute conditions. Indirect health consequences may occur as a result of exposures to harsh environments or disruption of the usual care of chronic conditions. Significant community disruption with power and utility failure forces chronically ill individuals needing technology assisted care to seek help even when they remain in their usual state of health. These patients may only need a source of electrical power and shelter, while usual caregivers continue their chronic care.

Acute illnesses unrelated to the disaster are likely to continue at usual or increased rates. The “worried well” are those individuals who are not seriously ill or injured, but may have symptoms or exposures that cause them concern. They may seek treatment or prophylaxis in large numbers. Young children separated from their families may be difficult to evaluate diagnostically if no history from a caregiver is available.

**Age-specific numbers of children**

In order to plan for pediatric care in disaster responses, it is useful to anticipate the numbers of children who will need care. Anticipating the volume of pediatric surges depends on definitions. US Census data indicate that in the total population, children in the following categories, birth to 4 years, 5 to 9 years, 10-14 years, and 15 to 19 years account for 6.8%, 6.6%, 6.9%, and 7.2% of the population, respectively. If a disaster affects all ages equally, then children would account for 20.3% or 27.5% of the disaster victims, for those 14 and younger, or 19 and younger, respectively. The younger the patient, the more unique the age-specific needs for care.

In a large event indiscriminately affecting all segments of the population, it is likely that children will need care in proportion to their numbers in the population. Needs of vulnerable populations might be overrepresented (children, elderly, disabled, chronically ill, non-English speaking, low income). Alternatively, one can imagine events in which children are disproportionately affected. This may occur on the basis of accidents involving a facility that serves children such as a school, as a result of a natural pathogen to which children are especially susceptible, or in a terror-related event intentionally targeting children.
Although federal agencies have defined hospital inpatient surge targets for planning purposes, no guidance has been provided regarding planning for the number of children.

**Pediatric Resources: Total & Surge Capacity**

**Benchmarks, local data, and definitions**

Whether resources are expressed as national benchmarks, or reported for representative regions, such data are not as useful to disaster response planners as empirical local data pertaining to the particular region. In addition, planners should be aware of the local definitions of “pediatric” capability in each facility. “Pediatric” services may be identified by self report, by accreditation (an impartial agency certifies that specified services are available at a hospital), or by designation (a government authority identifies specified hospitals that should be used for specified types of patients).\(^\text{17}\)

**Prehospital resources**

Pediatric prehospital emergency resources have improved in recent years driven, in part, by federal Emergency Medical Services (EMS) for Children Grants, requiring performance measurement and annual progress reporting. These include pediatric medical direction for prehospital providers, pediatric equipment in ambulances, systems to classify hospitals according to their pediatric emergency capabilities, interfacility transfer guidelines and agreements, and pediatric education of prehospital providers.\(^\text{18}\) State-by-state data on these performance measures have not yet been published. Gaps in planning prehospital pediatric mass casualty responses have been identified.\(^\text{19}\) Nationwide, 73% of EMS agencies have a written plan for mass casualty responses, but only 13% have pediatric plans. Only 19% have pediatric triage protocols. Although 69% of agencies participated in disaster drills in the previous year, fewer than half of the drills included pediatric considerations.

**Emergency department resources**

Emergency departments offer widely varying levels of care for children ranging from teams of subspecialists at comprehensive regional pediatric centers, to the most basic capabilities at small non-pediatric hospitals. All hospital EDs must be capable of providing initial pediatric resuscitation and stabilization. Infants or children with life-threatening conditions may arrive at any hospital any time.\(^\text{20}\)

Recent surveillance\(^\text{22}\) indicates that among the 4800 nationwide hospitals with a full time ED, 55% serve fewer than 4,000 children annually, while 17% serve more than 10,000. Fifty three percent of EDs admit children to their own hospital even though no separate pediatric area is available. Thirty seven percent report having a pediatric ward, and 10% report having a pediatric ICU (PICU) within their own facility. For those lacking a PICU, 2.5% admit children needing intensive care to an adult ICU within their hospital, while 97.5% send them to another facility. Fourteen percent of EDs report having a pediatric trauma service within the hospital. Four percent use other services to provide inpatient trauma care at that hospital, while the others transfer pediatric trauma patients to other facilities for inpatient care.

For trauma-intensive disasters, surge capacity may be determined more by trauma team capacity rather than other ED or inpatient resources. It is estimated that a hospital that can
provide 5 trauma teams can manage 30-40 casualties in the first hours after an incident, including 5-7 with injuries needing immediate care5.

**Pediatric hospital resources**

The most comprehensive pediatric hospitals may be defined as those with the highest patient volume and widest diversity of patient disorders. In a study of New York State hospitals, 11 pediatric hospitals defined in this way each serve regional populations (all ages) of 1.7 ± 0.3 (SD) million in 8 statewide referral regions. These 11 hospitals care for 29% of all pediatric hospitalizations, 0-14 years of age22. Most of the remaining children are hospitalized at less comprehensive pediatric hospitals, with a smaller number at non-pediatric facilities23. Among states there are wide variations in regulatory practices to identify pediatric hospitals and to promote the utilization of particular hospitals.

**Inpatient total peak capacity**

Better identification of pediatric inpatient resources for disaster care is a current priority of federal agencies24,25. In particular, improvements are needed in tracking the availability of pediatric non-ICU hospital beds and PICU beds. Federal efforts also seek to identify total numbers of burn, negative pressure isolation, and operating room capabilities available for patients of all ages, as well as adult medical-surgical and adult ICU beds.

Complete data on pediatric inpatient resources are not available on a nationwide basis. Even where information on administratively certified beds is available, this may overestimate functioning capacity for which staff, equipment, and supplies are really available24. No published data describe numbers or distribution of negative pressure isolation beds.

A study in New York defined regional hospital peak capacity empirically for all pediatric inpatient care. Capacity was estimated as the sum of each hospital’s 95th percentile highest occupancy by children, ages 0-14 years, over a several year period26. This provides a measure of functional, rather than administratively defined, capacity. Statewide, a peak of 703 pediatric inpatients per million age-specific population, 0-14 years, can receive care. This is much fewer than the peak capacity for older patients of 3045 inpatients per million age-specific population.

**PICU total peak capacity**

National surveillance indicates a capacity of 54 PICU beds (regionally varying from 36-66) per million age-specific population, 0-17 years (equivalent to 65 PICU beds per million age-specific population, 0-14 years)27. A similar estimate of 68 PICU beds per million age-specific population, 0-14 years, is available in the New York City metropolitan area28. A negligible number of dedicated pediatric trauma or burn ICUs are available nationally27. Most pediatric trauma and burn patients receive their care in general PICUs, adult trauma units or adult burn units.
Vacant capacity for new disaster surge patients

Functional peak capacity is a useful measure of resources available for disaster care. It is even more important to know how many new patients could be served in a disaster surge, above the number of patients already occupying beds in each part of the system\textsuperscript{24}.

Emergency department surge capacity

In many regions, existing plans for prehospital and ED disaster responses tend to be better developed and practiced than inpatient care. However, national observations indicate that EDs frequently operate near their peak capacity, with 10% of hospitals diverting ambulances at least 20% of the time. In addition, limited inpatient capacity forces EDs to board inpatients awaiting admission; 90% of US EDs board inpatients for at least 2 hours, and 20% board inpatients for at least 8 hours\textsuperscript{29}. Thus ED surge capacity is often limited by prior and ongoing patient care needs.

Hospital surge capacity

In many communities, vacant pediatric beds to accommodate disaster surges are far more limited than beds for adults. For example, New York State can provide an average of 268 vacant functioning beds (PICU plus non-ICU) per million age-specific population, 0-14 years. Vacancies decline to 193/million during periods of high baseline occupancy on winter weekdays, and increase to 328/million during periods of low baseline occupancy on summer weekends\textsuperscript{26}. Across eight NY State regions, average pediatric vacant capacity ranges from 156 to 359 beds per million. These data indicate that mass casualty events involving 50 pediatric hospitalizations per million population usually could be accommodated, but events exceeding 200/million often could not\textsuperscript{28}. Comparable NY statewide data for adults are 555 average vacancies per million age-specific population, (seasonal range = 328-733/million)\textsuperscript{26}.

PICU surge capacity

With an average baseline occupancy of PICU beds well over 50\%\textsuperscript{27}, regional PICU resources would be quickly overwhelmed even by a moderate disaster. For example, New York City’s 13 PICUs providing just over 100 PICU beds for 1.6 million children, 0-14 years old, often would be unable to accommodate 15 new PICU patients/million, and would almost never be able to accommodate 30/million\textsuperscript{28}. Functional PICU capacity may be limited more by available mechanical ventilators than by physical space.

Regional Triage: Matching Needs & Resources

Challenges

Many factors in a disaster would interfere with regional triage. The cause of patients’ illness may not be understood at an early phase in the event. If there is reason to suspect that a communicable infection or dangerous toxin is involved, the safety of providers and security of facilities would be triage concerns. Volunteers at a disaster scene may hinder the work of professional providers and endanger themselves.

Self transportation of casualties or uncoordinated distribution of patients by EMS providers would overcrowd hospitals near a disaster scene. Non-pediatric hospitals should expect to
receive pediatric patients. Transportation may be obstructed by damaged infrastructure, heavy traffic, lack of fuel, or community disorder. Communication may fail as a result of system overload, incompatible equipment, lack of training in use of equipment, and damaged communications infrastructure.

Healthcare staff may not be available if they are directly affected by the disaster, or because of conflicts between their professional and family responsibilities. Hospital supply inventories may need restocking at frequent intervals. Hospitals across a region must rapidly shift from acting as independent competing businesses, and instead coordinate their services under public authority.

Children must be supervised continuously, especially if separated from their families. Providers would have to deal with families seeking children or refusing to be separated from their children needing care.

**Triage strategies**

The following options are available to decision makers, but the appropriate combination and sequence of interventions must be individualized for each event and community. Detailed discussions of regional triage strategies have been published\cite{5,12,30-34}, but pediatric issues have not been considered in a quantitative way, previously.

**Incidents**

In an incident that stresses local prehospital services and a single hospital, triage would usually be conducted by on-scene and in-hospital decision makers. Incident Command principles include the appointment of an incident commander, triage officer, organization of personnel, vehicles, equipment, supplies, and security. Prehospital providers from neighboring areas might participate in the response. At the involved hospital, elective procedures might be cancelled, and selected inpatients discharged rapidly, thus reducing inpatient occupancy by 10-20% below usual levels\cite{26,35,36}. Individual patient triage at the scene and again on hospital arrival would identify needs for care. Decontamination and immediate interventions would be provided to those who require it. Appropriate delayed or minimal care would be given to others. Rapid movement of patients from the ED to operating rooms, inpatient (ICU or non-ICU) areas, or alternative care sites in the hospital would allow the ED to accommodate additional patients. Frequent reevaluation of needs and resources would optimize ongoing triage decisions.

Hospital resources would be extended by any of the following actions: temporary credentials given to additional providers by predetermined criteria, use of standing order templates, simplification of the medical record (maintaining information on identification, triage status, diagnosis, treatments given), less radiographic and lab testing with more reliance on clinical judgment, reuse of some disposable equipment, reducing standards of privacy and confidentiality, increasing the number of patients in each room, and placing patients in areas not usually used for inpatient care.

Pediatric-specific resources may be extended by any of the following actions: Two-tiered staffing in which specialists supervise teams of less expert providers (whether in ICU or non-ICU areas) to care for expanded numbers of patients, just-in-time training, care of adolescents and older children in adult areas, and care of severely ill infants in neonatal ICUs. Mechanical
ventilators for older children may be obtained from adult ICUs, while ventilators for infants may be available in neonatal ICUs. Patients would be identified for transfer when possible, including: mildly ill children to alternative non-hospital sites; inpatients from a non-pediatric to pediatric hospitals, or from an overcrowded to less crowded pediatric hospitals; and very severe patients to more comprehensive pediatric, burn, or trauma centers. Outside personnel and supplies could be brought into the hospital.

Large disaster

In a large disaster the services of an entire region may be overwhelmed. Some or all of the strategies outlined above for an incident would be implemented. A central authority for that jurisdiction would coordinate the flow of information and would make decisions about the distribution of patients and the allocation of resources. Information must be available about patients and resources across the region, including care of prior patients unrelated to the disaster.

The coordinating authority would attempt to maintain a balance between needs and resources at hospitals near the scene of a sudden impact event. Many patients would be sent to remote hospitals with vacant capacity. The most critically ill patients may warrant transport to nearby facilities for immediate lifesaving interventions. Some very severe patients might be directed to appropriate comprehensive hospitals even if these were not close to the scene. It would be important to avoid overloading nearby hospitals with early waves of mild patients, interfering with later responses to large numbers of severe patients, especially if the nearby facility happened to be one of the few available children’s hospitals.

Communications with the public and efforts of security services would attempt to control the destination of self transports. Alternative sites (evaluation centers, non-hospital acute care centers) would be opened as needed to supplement the services of hospitals for patients not requiring inpatient care. It may be possible to arrange mass transportation of mildly ill or injured patients in buses or vans, keeping ambulances free for severe patients. As circumstances of the disaster become clear, the coordinating authority would also provide information toprehospital providers and hospital staff to help them anticipate specific patient care needs and treatment recommendations.

It may become necessary for the coordinating authority to alter standards of care across the region, attempting to maximize population outcomes by providing interventions only to those immediately in need, instead of maximizing individual outcomes. This approach may have already been implemented by triage officers at the scene or at individual hospitals. However, imposing such changes on a regional basis prematurely could worsen population outcomes. Quantitative models providing real-time analysis of the consequences of alternative regional triage strategies may assist decision makers.

When possible, redistribution of patients to other hospitals, including those in adjacent regions, may be necessary to better match their needs and levels of care. Additionally, resources may be brought into the region, including equipment, supplies, and supplemental personnel.
Communications

In order for regional coordination to succeed, information on needs and resources must be shared among providers, decision makers, and the public. State and federal efforts are in progress to track and share such information. Communication among agencies requires functioning and compatible equipment, used by trained providers, and protected against overload by the high volume of communications, and protected against other disruption. Communication about health concerns and treatment recommendations from decision makers to the public is ideally provided via public media by a recognized spokesperson from the public health or medical community. Public cooperation is related to the consistency and credibility of information they receive.

Transportation

Transportation is a vital resource necessary to match needs and resources across a region. Local prehospital providers using standard ambulances may be sufficient in a modest size incident. In large emergencies, the resources of neighboring communities would be called in to help. Other public and private vehicles may be used, including vans and buses to transport less severe patients. In very large disasters, the transportation resources of the federal Department of Defense, Veterans Administration, or Federal Emergency Management Agency may be necessary to assist in evacuation of the general population and mass transport of casualties.

Authority

The legal and regulatory basis to carry out regional triage has been outlined by the federal Department of Homeland Security in the National Response Framework, 2008. Incidents are always managed at the lowest possible jurisdictional level. Most incidents are successfully handled at the local (city or county) level of authority. Responses to some disasters need support from neighboring jurisdictions or the state. Only a small number of events require federal support or authority. In an event potentially related to terrorism, federal authorities would be involved at an early stage. The Incident Command System provides a decision-making and coordinating process that enables agencies with various legal, jurisdictional, and functional responsibilities to plan and coordinate the response. The Incident Command System can be scaled to any type or size of event, and is compatible with authority at any jurisdictional level. The usual chain of command within each participating organization should be maintained, with coordination across organizations and jurisdictions. Effective responses require prior planning and practice by participating organizations, all tailored to the circumstances of the region. In a public health or general emergency, authority is available to give public decision makers temporary power to direct the use of private resources.

Preparing for difficult regional triage choices

Ethical as well as practical medical issues must be addressed in order to plan regional disaster triage. Public and professional cooperation will be best obtained from those who are well informed of plans, and who have an understanding of the interests involved. Poorly informed health care providers may have as great a difficulty altering care standards
in disaster triage as the general public. The perception of fairness is essential in gaining acceptance of triage decisions. Some of the following areas need attention:

- How much of scarce public and private resources should be allocated to disaster-specific preparation versus all-hazard preparation that serves routine daily needs as well as disasters?
- Who gets care when some must be denied care?
- Within a triage category, should interventions be provided on a first come - first served basis? Or are some individuals assigned a higher priority than others? Who decides?
- In working to maximize population outcomes, is the goal to save the most lives, the most life-years (favoring the young), or quality-adjusted life-years?
- How would outcomes, including age-specific differences, be predicted in order to make these decisions?
- What is the minimally acceptable level of care, ethically?
- What is the minimally acceptable medical level of care to achieve desired outcomes?
- What interventions should we attempt to guarantee, and what interventions should we forgo, in attempts to accommodate specified increased numbers in a disaster surge?44
- Population outcomes may differ substantially depending on small differences in triage rules [reference 5, pg 18-20]. Given that the legal basis for disaster care remains incompletely defined, what is the liability for providers who limit, withhold, or withdraw care?45

Understanding must be developed by public debate and discussion. Some of these questions may be answered as lessons learned in responses to future incidents and disasters. Collection of empirical evidence pertaining to regional triage is a priority.

**Planning**

General considerations for the regional triage planning process have been outlined by various agencies and professional experts [12,30,31,33,42,46]. The elements outlined in this chapter must be addressed with local data in order to develop plans for each region.
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Chapter 6: Pediatric Urgent Care

Paul Sirbaugh MD

Mobile Pediatric Emergency Response Team (MPERT): An Acute Care Pediatric Response Operating within an Alternate Care Facility

Introduction

All disaster planners should focus on regional resource utilization rather than resource recreation when preparing for a multifaceted response. While adhering to the local incident command system (ICS), experienced and resource-rich experts from every subspecialty (i.e. pediatrics, geriatrics, obstetrics, etc) and every sector (i.e. private, non-profit, municipal, etc) of the community must be invited to participate in the planning of a region's disaster response. The resources must also be allowed to operate independently within their fields of expertise. These recommendations may sound inherently obvious to most, but intentionally or unintentionally, the lead governmental agencies in charge of disaster planning and response (LGAs) too often discount the importance of accessing and involving regional resources, citing concerns over battling egos, too many "cooks in the kitchen", budgetary constraints, and/or schedule conflicts. While those concerns are legitimate, and often in fact the reality, the benefits of collaboration include a more efficient product that results in:

- A shortened preparation time
- A better distribution of the workload among knowledgeable partners
- Practice drills that focus more on maintenance and less on the recreation of preexisting processes that have already been tested, retested, and fine-tuned by the resource
- A more functional and reproducible model for an all-hazards multi-faceted disaster response
- Sound exit strategies

The content of this chapter is applicable and essential to existing pediatric tertiary care resources, as well as to the LGAs that require their expertise before, during, and after a disaster response. Regional tertiary care centers will be affected by any disaster response in their community and regardless of whether or not they are invited to the table, those centers must be proactive and force their way into the planning of the every phase of a disaster response. This chapter details an example of one region’s utilization of a willing and able tertiary pediatric care resource, resulting in the successful creation and implementation of a field-tested mobile pediatric emergency response team (MPERT). Using the resources of a regional tertiary pediatric care hospital (RTPCH), the MPERT, in less than 24 hours, recreated a scaled-down version of the resource’s emergency center and provided around-the-clock staffing, equipment and supplies to the county’s alternate care facility (ACF). In less than 12 days, approximately 3500 children (≈ 290 patients/day) were treated and released by the MPERT with fewer than fifty of those patients requiring transport to the RTPCH. The MPERT virtually doubled the RTPCH’s surge capacity.
Of note, the author of this chapter has focused on one very small but critical piece of a disaster response - the pediatric clinical response. It is based on the simple assumption that the infrastructure (e.g. structure, plumbing, beds, etc) for the response is orchestrated through the efforts of another resource (i.e. LGA designee).

Pre-event planning:

Invitation to participate (out of sight, out of mind)

Pre-event planning is paramount to a successful disaster response. Part of that planning must include an “invitation to participate” by LGAs to all legitimate entities likely to be affected by an all hazards disaster response. Too often and without explanation, pediatric expertise and representation is left off of the local and regional invite list. Recognizing this reality makes it essential that the RTPCH insert itself into the regional planning process. Federal recognition of the importance of including the vulnerable populations into national disaster preparedness efforts has improved over the years, mostly through the work of national organizations like the American Academy of Pediatrics (AAP)². However, regional pediatric hospitals must continue to focus their efforts locally in an effort to establish working relationships with their community disaster planners. Understandably, not every RTPCH will be rushing to participate in this endeavor. It is the opinion of this author that there are really only two options for the RTPCH; participate early (pre-event) and exercise some control over the planning, implementation, outcome, expense and reimbursement of the response or react post-event and hope for the best. Either way, the RTPCH will be participating in the response.

Regional Pediatric Disaster Response Preparedness Group (Pediatric Preparedness Group or PPG)

In the event that there are several RTPCHs in the region they should organize and collaborate, perhaps with the assistance of LGAs, in an effort to coordinate their response. One method of achieving this unified subspecialty response is to create a regional PPG that meets throughout the year and whose members include essential representatives from each of the respective RTPCHs. As a group, they could create boundaries for their response. In Houston, during the response to Hurricane Katrina, there were two main sites established in an effort to meet the shelter and medical needs of the over 25,000 evacuees from the New Orleans Superdome. Harris County and the Baylor College of Medicine provided the resources for one location (Reliant Complex), and the City of Houston in collaboration with the University of Texas supplied the resources for the other (George R. Brown Center). Both locations, while operating independently of one another, remained in constant communication and shared resources whenever the need arose. While this group of representatives from RTPCHs was not in existence before the Katrina response, it has since been formed and among other things is currently developing memorandums of understanding (MOUs) between institutions and contracts with LGAs to help assure cooperation and funding during the next disaster response. Another example of this coordinated response is the sharing of subspecialty services. RTPCHs can plan ahead to share the burden of a surge in patients by working as a group with LGAs and local emergency medical services (EMS) agencies to create algorithms that will assist in the distribution of
specific patient populations to designated centers based on criteria such as age, type of injury, or even acuity of illness.

Reimbursement

Arrangements for reimbursement should be made early in the planning phase. This effort is usually done on the part of the RTPCH financial officer and LGA officials through MOUs and contracts. The MPERT leadership team will play a crucial role in getting buy-in from RTPCH administration (including the board of directors) and estimating the outlay of expenses. The RTPCH during the Katrina response was not involved in the planning and unfortunately not part of the FEMA reimbursement package that was arranged between FEMA and the LGA. As a result, the RTPCH was not reimbursed for its efforts.

Creation of a Mobile Pediatric Emergency Response Team

The odds of actually implementing an MPERT is slim to none in many regions, so its creation should therefore involve institutions with preexisting, field-tested and operational processes for providing emergency medical services with little or no warning. Those departments must also be able to manage large volumes of patients with variable acuity. There is no better resource for this talent than a RTPCH emergency center (RTPCH-EC). With the proper leadership, hospital support, and pre-event planning and practice any RTPCH-EC could relocate its day to day operations into an established ACF.

Leadership and hospital support is paramount. Selecting the medical director should be the first phase in the process of creating an MPERT. Qualifications should include training and experience in prehospital, emergency and disaster medicine. He/she should have the full support of the RTPCH’s administration and be given the authority to make decisions on-the-fly during a disaster response.

The medical director should then organize a small, talented and focused team of essential players who will ultimately make the MPERT a reality. Again, those essential team players should be experienced in the pediatric emergency medical services environment and assigned to duties that represent their current job descriptions at the RTPCH. Each team member must have the authority, resources and capability to operate independently of one another. The purpose of the team is to coordinate each of those services utilizing existing RTPCH resources at an ACF. Their effort should mirror what occurs every day in the RTPCH. That experienced utilization of existing resources is the centerpiece of the MPERT. They should meet frequently and make every effort to base the design of the response on a general all-hazards approach to disaster planning. When they are not responding to disasters, these team members may fulfill various roles in disaster planning for the RTPCH (i.e. evacuation, special needs shelters, etc.) but their assignment to the MPERT should be based on their individual capabilities as they team up to create the pediatric emergency medicine clinical response in an ACF. Members should not be assigned to the team solely based on their availability.

At an absolute minimum, each team member should be certified in the National Incident Management Systems (NIMS) as well as Basic and Advanced Disaster Life Support (BDLS and ADLS). The team should include:
Mobile Pediatric Emergency Response Team

**MPERT Medical Director** – The physician managing the MPERT should be experienced in both prehospital and emergency medicine. The medical director should also be closely aligned with his/her respective RTPCH disaster liaison (see job description below) and together both should build cordial and long-lasting working relationships with community leaders and other RTPCHs. In the perfect world the MPERT medical director should have an official position within the LGA medical response designee incident command (IC). The medical director of the MPERT during the Katrina response was credentialed full-time faculty in the pediatric emergency section as well as director of prehospital pediatrics for the RTPCH assistant medical director for the City of Houston, EMS. He was in constant communication with the RTPCH’s disaster liaison (now the RTPCH’s Assistant Director of Emergency Management). Soon after the clinic began operations, the LGA medical response designee recognized the vital role that the MPERT played in the care of pediatric patients and as a result formally made the medical director part of onsite medical incident command. The medical director attended and actively participated in the twice daily IC meetings. The better option is to have the MPERT medical director assume a position with IC before the response (e.g. early in the planning and preparation phase).

**MPERT Nursing Director** – In addition to having experience in emergency and disaster medicine, the nursing director should also be experienced in field triage. The ability to triage is a unique talent often genetically possessed and experientially fine tuned by emergency nurses. This is not always the case for physicians who historically have difficulty overlooking a challenge, and there is no better challenge than attempting to resuscitate a recently deceased or dying patient.

**Disaster Liaison** – Every pediatric hospital should employ a disaster liaison. As the hospital’s community representative for disaster planning and preparation, the liaison will maintain close connections with community disaster planners and regional LGAs. The position also allows the RTPCH to maintain a “pulse” on community planning efforts, and visa versa. The disaster liaison could represent the RTPCH at PPG meetings and could also fulfill the role as go-to person for LGAs. For example, whenever a disaster drill or response is imminent, the LGA would simply contact the respective disaster liaison (or his/her representative) by phone. It is then the responsibility of the liaison to activate his/her RTPCH’s response. This single phone call could lead to a well-orchestrated effort by an experienced, capable, and willing partner in disaster response. Based on qualifications and personal interest this position was filled by the Director of Nursing for the Emergency Center (EC) during TCH’s response to Katrina. As a result, this dual role of disaster liaison and nursing director resulted in the loss of leadership in the EC prior to, during, and for some time after the response. For that reason it is recommended that someone without a competing job role fill this position.

**Lead hospital administrator liaison** – This liaison was not clearly defined during the Katrina response but for all practical purposes included the RTPCH’s Chief Nursing Officer (CNO) and Chief Operations Officer (COO). The hospital created an around-the-clock (ATC) command center with one central phone number at which each of these administrators were accessible for on-the-fly decision making. A phone line was created onsite at the MPERT and as a result, any and every clinic need was quickly addressed by the RTPCH command center leadership.
**Pharmacy liaison** – An onsite pharmacy, with pediatric-specific medication and supplies and ATC staffing, is essential to the effort. The response should include an on-site pharmacist ATC to fill prescriptions, protect supplies, and manage inventory. TCH’s Director of Pharmacy assumed the leadership role during the Katrina response and was very involved in virtually every segment of the response. Disaster planners should consider making the pharmacy liaison a co-leader in the preparation and implementation of any disaster response. Their training and expertise is integrated into almost every facet of the emergency medical response.

**Central supply (CS) liaison** – Children are not little adults. For that reason alone, equipment and supplies specifically indicated for children must be readily accessible during a disaster response. The CS liaison should know the complete inventory of supplies and equipment as well as the limitations of his/her department. He/she should be readily available during the implementation of an MPERT, and there should be a mechanism by which MPERT staff can order and expect to receive needed supplies during the response. Prior to a disaster response, he/she should also take into account the potential needs of operating an MPERT for 7 days and include those needs into the inventory when calculating off-site storage of medications, supplies, and equipment for any disaster response. The team leader representing central supply during the Katrina response was the Director of Pharmacy but this shared role may not be applicable in other centers.

**Physician staffing coordinator** – This is a full-time position during a disaster response and the job description includes finding, credentialing, scheduling, and coordinating the assignments of physicians and mid-level providers from every subspecialty. This individual should work in physician staff services at the RTPCH and be familiar with and proficient at each of the roles listed above. During the Katrina response, the responsibilities for this role were divided among specialty lines. Initially a senior faculty member of the RTPCH section of emergency medicine was assigned the job of scheduling sub-board pediatric emergency medicine (PEM) faculty and fellows – the leadership of the clinic. A lead hospital administrator whose daytime job included hospital liaison to community pediatricians, assumed the role as coordinator of pediatricians and mid-level practitioners - the workforce for the clinic. There was no shortage of physician and nursing volunteers during the Katrina response and as a result locating staff to cover the clinic was often easier than providing coverage for the RTPCH-EC. This would not have been the case without a sound exit strategy. Early in the effort, the RTPCH leadership made it very clear to the LGA that the RTPCH response would be limited and based on necessity. Once the leadership of the MPERT felt that the LGA medical provider designee (e.g. Baylor College of Medicine and the Harris County Hospital District) could take over the medical management of the MPERT, the RTPCH would plan for a gradual transition and an organized exit.

**Nursing and ancillary staffing coordinator** – This position should be filled by a nurse or administrator knowledgeable and experienced in the RTPCH workforce capabilities and scheduling. Depending on the needs of the MPERT this position may include more than one person. For example, if ancillary services other than nursing are needed for the MPERT (e.g. radiology and lab), representatives from those sections should be present to offer insight into their scheduling and personnel capabilities. This was not necessary during the Katrina response because the all lab and radiology services provided by the LGA medical response designee were adequate.
Infection control liaison – The job description for this position is self-explanatory, and the role should be filled by someone with an expertise in epidemiology and disease surveillance. Outbreaks of infectious disease can be expected during a disaster response, especially one involving shelters and children. Early identification, surveillance and containment within the shelter and MPERT are crucial to the prevention of an outbreak involving the general population.

Social services liaison – Social issues, such as separation of children from their parents and/or guardians and mental illness, were not addressed well in the initial phase of the Katrina response. Children, elderly, and mentally ill patients presenting to the Katrina ACF without family members to guide them through the process went unnoticed at times. The role of social service liaison is an important one and should be filled by someone with a working knowledge of available non-profit, faith-based, protective services, local, state, and federal resources.

Handbook

Early in the Katrina response the burden of educating every new provider and volunteer on the policies and procedures of the clinic was distracting and overwhelming to the MPERT leadership. On the third day of clinic operation the medical and pharmacy directors created a handbook. Every new provider was required to take 15 minutes to familiarize themselves with the contents of the handbook. Items were added to and deleted from the handbook on a daily basis, allowing it to evolve with the clinic.

All of the team members need to collaborate on the creation of a handbook for providers. While some policy and protocols will be unique to each MPERT, all should include:

- Orientation to the MPERT
- Summary of NIMS and a brief description of IC
- Names, titles and phone numbers of LGA incident command and MPERT leadership
- Policies and procedures for the clinic (e.g. registration, ordering of labs and x-rays, hours of operation, scheduling, clinic access, security, parking, transportation to and from the clinic for patients and family members, etc)
- Physician, nursing and staff duties and responsibilities
- What it means to be a volunteer at the MPERT
- Credentialing and identification
- Essential phone numbers
- Orientation to pharmacy and central supply
- Infection control procedures
- Map of the ACF (include provisions and locations of bathrooms, showers, and sinks)
- How to contact and mobilize emergency medical services
- Social and mental health services available to the patient, family, and health care provider
• Injury prevention on the job

Practice drills

Rehearsal for the MPERT occurs every day the RTPCH-EC is in operation. The MPERT should reflect the day-to-day operations of the RTPCH-EC. The only significant difference pertains to the mobility of its parts. Essential team members must be flexible enough to mobilize each of their service lines to an ACF site. Sample schedules, inventories and drills will of course help to make that plan a reality.

Notification, Activation, and Implementation of the MPERT

The notification and activation of the MPERT

Historically the process of notification with regard to an impending disaster is less than perfect. It was no different during the Katrina response. Local media outlets recognized that LGA officials were overwhelmed and undermanned by the large volume of patients from New Orleans. They reacted by making an on-air request for additional medical support. In response to that request, pediatric emergency medicine physicians from the local RTPCH appeared onsite and began triaging, evaluating, managing and dispositioning children numbering in the hundreds. Although the waiting room and clinic layout was unfamiliar and the physical space and bed capacity were inadequate, the routine was the same for the seasoned RTPCH staff – large volumes of patients with multiple conditions of variable acuity. The only thing missing was the opportunity to plan ahead for such an event.

In a well planned and orchestrated response based on the existence of a good working relationship between the LGAs and the RTPCH, an LGA designee would immediately notify the RTPCH’s disaster liaison of an impending disaster response involving children. If an ACF is in the works and the need for pediatric expertise is imminent, the RTPCH would then activate the MPERT and begin the planning and preparation for its implementation.

Implementation of the MPERT

After the activation the essential team members would convene a meeting with the RTPCH command center staff and the process of assessing the needs, building the MPERT, and organizing the response would begin. This is the easy part. The resource is not developing a new product; it is merely transplantsing its expert services to another location.

COMMUNICATION

MPERT and the RTPCH – If a phone line (or cell phone) is available the problem is solved. Direct communication between the RTPCH command center and the MPERT leadership is helpful with managing inventory, staffing, patient transfers, etc. If cell phones are being used to maintain communication between the RTPCH and the MPERT, there should be one main line that remains affixed in some manner and central to the charge nurse. In addition, electrical outlets and extra batteries are essential. Early in the Katrina response, communication was frequently interrupted due to dead batteries. Also important is the communication between the RTPCH board of directors (BOD) and the MPERT leadership. Frequent updates with reference to an exit strategy helps keep the focus on the MPERT and
its important but limited mission. The MPERT will cost the hospital money and it will also save the hospital money. It is the responsibility of the MPERT leadership to keep the BOD informed. At an update to the BOD during the Katrina response one of the members pledged a large donation toward the efforts of the RTPCH and its MPERT.

**MPERT and LGA IC** – The best possible outcome for both the LGA IC and the MPERT is for the MPERT medical director to assume an official position with the onsite IC staff. If that is not set up early in the planning, it is unlikely to occur during the response. If not part of the IC, the medical director should make every effort to operate efficiently and for the most part, under the radar with frequent and open communication with the LGA IC.

**LGA IC and the RTPCH** - Even more important is the communication between the RTPCH leadership and the LGA IC. Respecting the LGA IC structure is difficult for anyone, especially those who are accustomed to being in control at their day job. The resource will rarely be in control of the overall response. The resource may and should be respected for their influence and effort, but rarely does the LGA IC structure share ranks with the resource. Stay focused on the goal at hand (managing the needs of the children) and if necessary and within reason, acquiesce to the requests of the IC. The IC is often made up of law enforcement, government, and/or military personnel and if they suspect insubordination, they can and will shut down even the most functional process in seconds.

**MPERT leadership and the workforce volunteers** – Volunteers are the backbone of the clinic. They respond well to clear and concise instructions but not to abusive rants. Scheduled and unscheduled meetings involving clinic staff that summarized recent updates, were found to be useful during Katrina, as was the handbook that was revised daily.

**Media and the MPERT** – This is an easy one – don’t do it. There is usually a very structured public relations (PR) piece built into the LGA and its PR designee. Don’t risk harming the relationship between the MPERT and the LGA. Only provide PR regarding the clinic when given permission by the LGA. The same is true for the RTPCH when it comes to discussing anything that is taking place at the ACF.

**Phone list** – A list of important phone numbers should be created and shared with essential team leaders during the planning phase of the MPERT. That list is likely to evolve greatly in number during the implementation phase.

**STRUCTURE AND FLOW**

The team will rarely have any input into the physical design and location of the MPERT. The focus of the MPERT leadership is on clinical care. However if feedback is welcome feel free to provide input. The focus should be on:

- **Square footage** – One third of the patients are likely to be children, so 30% of the space should be reserved for the MPERT.

- **Limited access** – There should only be one entrance to the clinic, and it should be closely guarded and monitored by unarmed security. Equipment will walk, so security is essential. There should also be limited access to the pharmacy and central supply to prevent theft of drugs and supplies.
• **Room for expansion or retraction** – A larger-than-expected number of pediatric patients presented to the Katrina MPERT. In response to that fact, the LGA added hundreds of square feet to the designated MPERT area within 24 hours. Within 48 hours a diarrhea outbreak occurred and as a result, the LGA IC created additional isolation beds which were used to isolate the illness, infuse fluids, and keep families together. Square footage was removed from areas that did not require the space; this should be expected.

• **Waiting room** – There must be sufficient space for patients to wait to be seen and discharged.

• **Privacy and bed space** – This is obviously important to all patient populations and easy to accomplish with curtains and cots.

• **Flow** – If there is time to plan and advice is welcome, clinic flow designs should be based on published successful EC models.

• **Bathrooms, sinks and showers** – Staff and patient hygiene is one primary tool of prevention when it comes to infection control, especially during a disaster response. The best option will always be running water and soap. That fact notwithstanding, instant hand sanitizers and antibacterial hand wash were mainstays at the Katrina MPERT. Bathrooms and showers should be plentiful and in close proximity to the clinic.

**Decontamination**

Decontamination should occur before the patient ever arrives at the MPERT. If that turns out not to be the case (which is likely), showers and fresh clothes should be readily available to the clinic and its patients.

**Triage**

At least one PEM nurse should be present at each triage location to insure that the proper assessment is provided and level of acuity is assigned to every pediatric patient. They are usually welcomed by the LGA designee staff, but consider the importance of communication skills when choosing the nurse. If triage is properly performed at the point of patient arrival, additional triage at the MPERT is probably not necessary.

**Patient identification, registration, tracking, and online medical records**

One of the biggest problems during the Katrina response was the lack of patient identification and tracking and the timeliness of patient registration. Technology has responded to each of those problems, and there is no excuse for any LGA to ignore these issues in the future. While patient identification, registration, tracking and online medical record keeping are probably not going to be the sole responsibility of the MPERT, the staff will need to be familiar with each of the products that are chosen by the LGA and cooperation with the process is critical. Separation of family members should also be avoided and clinic staff should also be reminded of and attentive to HIPAA regulations.

**STAFFING AND SCHEDULING**

Historically, there are large numbers of volunteers from every walk of life interested in doing their part to support a disaster response. While appreciated and essential to an MPERT, most
of those volunteers have full-time jobs, families, and/or other obligations that prevent them from working extended periods, night shifts, holidays, and weekends. The Katrina response began over the Labor Day weekend. Initially there seemed to be an infinite number of qualified volunteers, all willing to work for a common cause. However, by Labor Day it was clear that most of the clinic staff were limited to paid faculty and staff.

Patient volume, condition and acuity as well as staff availability will dictate staffing and scheduling. The scheduling of nurses and ancillary personnel is critical to the success of the MPERT. Filling slots with staff from the RTPCH is the first step and everything else is helpful but superfluous. Included below is a generic model based on the Katrina response.

**The schedule** – Schedules should be created weekly and absenteeism should be strongly discouraged. The ability to predict the workforce for a given day is essential and making the expectations clear and concise early on in the process is critical. The only clinic during Katrina with adequate 24-hour coverage for the entire 12-day period was the MPERT, and part of that was because schedules were created from day one and expectations were enforced or volunteers were not invited back.

**Physician and nursing recruitment, credentialing and licensure** – There was no shortage of supply or lack of need for volunteers early in the Katrina response. Most of the physicians and nurses were recruited locally and from within the RTPCH and LGA medical designee roster. Other physicians and nursing volunteers simply showed up for work at the MPERT. Even more arrived after a call went out to the local, state and national AAP offices resulting in numerous physician volunteers from all over the state and country. While lack of state licensure was initially an issue, the State of Texas responded by allowing institutions to cosponsor physicians from other states. The issue of state licensure was less of a concern for nursing because traveling nurses are much more common than traveling physicians and as a result, reciprocity among states is much more common. Credentialing was a completely separate issue, and conflicts arose regarding which agency was ultimately the authority over credentialing. Creating a national system of credentialing disaster response physician and nurse volunteers is long overdue. Currently there are several national organizations that are making inroads into the effort, but a lot more has to be done before the concept becomes widely accepted^6,7_.

**Physician staffing**

- **MPERT medical director** – One (24 hour shifts/day and 7 days per week) or two (12 hour shifts/day and 7 days per week) physician/s with EMS and PEM training and experience are preferred. These faculty are responsible for overall medical direction of the clinic as well as providing feedback to the LGA IC and RTPCH. Everything in the MPERT ultimately falls under their oversight.
- **Shift medical director** – Two physicians - 12 hour shifts. These faculty members manage the workforce and flow.
- **Physician workforce** – Patient volumes of 300 patients per day were handled well using a minimum of four pediatricians/8 hour shift.
- **Subspecialty services** – 24 hours/7 day per week availability is required – on site availability is probably not required but depends on the response. Having arrangements with the outpatient services at the RTPCH is probably sufficient as it
was during Katrina. This is especially important when managing children with special health care needs (e.g. transplants, neutropenia, and renal dialysis). Having an off-site location to care for these fragile children is probably warranted.

**Nurse staffing**

- *MPERT nursing director* – Two (12 hour shifts/day and 7 days per week) nurses with EMS and PEM training and experience. These nurses manage and train the MPERT charge nurses on a shift by shift basis.

- *Charge nurses* – Three PEM nurses - 8 hour shifts. The role of the MPERT charge nurse cannot be overstated. As in the EC, patient flow is directly related to the talents of the charge nurse, and choosing the charge nurse should be not be taken lightly by the MPERT physician and nursing leadership.

- *Nursing workforce* – Four pediatric nurses - 8 hour shifts.

**Pharmacy and central supply staffing** (can be combined)

- *Pharmacy and central supply director* – One (24 hour shift/7 days per week) or two (12 hour shift/7 days per week).

- *Pharmacist* – one per 8 hour shift. During Katrina the pharmacist and a member of his/her workforce was also responsible for maintaining the medication, supply and equipment inventory. The charge nurse would verbalize his/her needs to the pharmacist who would phone in orders to the RTPCH twice daily unless emergent needs dictated more frequent requests.

- *Pharmacy and central supply workforce* – two per 8 hour shift.

**Clerk staffing**

- One clerk per 8 hour shift. The clerk should never leave their post. Their primary role during Katrina was to identify patients and staff. In addition they helped with virtually everything else but never left their secure post.

**Environmental services staffing**

- The cleaning staff is essential and should come from the RTPCH to insure that bed turnover is properly maintained in the MPERT. This is a limited resource in a disaster response, and due to the large volume of adult patients there were never enough cleaning staff to go around until the RTPCH shared its resource.

**Social services staffing**

- Early on in the response, social service personnel should be on site 24 hours/day. This schedule can be reduced depending on need, but off-site availability should be maintained 24 hours/day until clinic closure.

**Laboratory and Diagnostic Imaging (DI) staffing**
• Providing laboratory and DI services are probably cost-prohibitive for the RPTCH unless a contract is negotiated with the LGA. Sharing the services provided by the LGA with the rest of the clinics would probably be the best option.

EQUIPMENT, SUPPLIES, AND MEDICATION

Equipment, supply, and medication needs will vary and evolve with the clinic and should mirror, within reason and clinical demand, the RTPCH-EC. For example, asthma and attention deficit medications, antibiotics (topical, oral, intravascular, and intramuscular), and immunizations, as well as splinting, suture and IV hydration supplies, were used with greatest frequency during the Katrina response. Unless the LGA is in the business of caring for children, most of the equipment for the MPERT will have to come from the RTPCH. Whenever possible that equipment should be bolted to the floor or chained to columns. There should also be at least one pediatric code cart with a pedi-enabled automated external defibrillator and pads.

EMS

EMS and transport to and from the MPERT will likely be organized by the LGA. There should be one contact person (e.g. clerk) who organizes, creates backups and maintains an up-to-date list of arrival, disposition and final destination of every patient entering and leaving the clinic. To maintain consistency only one person (e.g. charge nurse) should be responsible for communicating directly with EMS. During the Katrina response, the City of Houston EMS system transported all 9-1-1 calls from within the city but not from within the Reliant Complex (home to the Houston Texans and at the time was the temporary location of the Katrina Clinics which included the MPERT). A for-profit EMS provider managed all EMS traffic coming from within the Reliant Complex. The Houston’s Catastrophic Medical Operations Center (CMOC) then coordinated the destination of every regional EMS transport regardless of its starting point. The CMOC, which was created in 2001 as a result of Tropical Storm Allison, becomes operational during a disaster, and its purpose is to coordinate the regional distribution of EMS transports based on bed availability and hospital capability (e.g. children’s hospital, Level I trauma center, burn unit, etc).

TRANSFERS

Unless identified as a hospital or emergency room, transfers from the MPERT probably do not have to follow EMTALA regulations. However, unless there is a central dispatch similar to Houston’s CMOC that is attempting to distribute patients only to institutions who have available bed space, communication with the destination hospital is warranted.

ATTIRE

Clothing should be nondescript (e.g. scrubs) and should not identify the sponsoring resource unless otherwise requested by the LGA. Unfortunately and despite a major effort to the contrary, the Katrina MPERT assumed the name of the sponsoring resource, which ultimately created divisions between the non-resource staff and the RTPCH staff.
CHANGE

Change is not always welcome but it is often necessary. Leadership should become comfortable with collaboration and change. They must make every effort to listen closely to their staff, act quickly to change the outcome, and reassess the results continuously. Processes that don’t work should be discontinued and those that do should be modeled.

SOUND EXIT STRATEGY

The administration of most RTPCHs is accustomed to time-lines and exit strategies. Going into the response without planning for an exit is unwise and likely to create undue confusion and expense. During the Katrina response it was clear to everyone in the RTPCH administration (including the BOD), MPERT leadership and LGA that the resource hospital would begin to transition its services over to the LGA’s medical designee as soon as the clinic no longer required 24 hours and 7 day per week clinical coverage. That transition occurred on Day 12 without complication.

Reexamination and Reflection

After the dust settles, the MPERT team members should meet collectively to share experiences and to discuss the successes and failures of the response. Ultimately, learning experiences should be documented and inserted into a new plan that can then be shared with the RTPCH (and with other RTPCHs from around the country) and LGA (and with all state and federal agencies involved in disaster preparation) in preparation for a future rollout.

Summary

No local, state or federal governmental agency can or should ever attempt to recreate the talents that exist within every tertiary pediatric care resource. Those resources exist in every region and like prodigies they practice their talents on a daily basis as they search for the most effective and efficient means of caring for their pediatric patients. Any governmental agency interested in utilizing a regional resource as opposed to recreating a new one can contact the author of this chapter at sirbaugh@bcm.tmc.edu or call at 832-824-5389 or the American Academy of Pediatrics at DisasterReady@aap.org or call at 847-434-7132.

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Chapter 7: Shelter Care Set-up

Richard Bradley MD

Unless exclusively serving an adult population, shelters must ensure that the physical and mental health needs of children are appropriately addressed, and that children remain with their families or caregivers to the maximum extent possible.²

Identification of need

Mass care operations provide basic human needs for food and shelter, and their prompt establishment after a disaster is essential. Well-identified shelters are often one of the first indications to disaster victims and affected communities that officials are initiating relief efforts.²

Providing emergency shelter is ultimately a responsibility of the local government. The Chief Elected Official of the local jurisdiction usually has a statutory role as the Emergency Manager. This individual will usually manage a crisis through a local government Emergency Operations Center (EOC). One of the primary responsibilities of the EOC is to obtain a clear understanding of the needs that exist as the result of the emergency. This normally occurs in the Situation Status Unit, which is part of the Planning Section. This unit has the responsibility to determine the scope of resources needed, including shelters, if necessary.

The Emergency Manager usually appoints a Mass Care Coordinator who actually makes the decision to open a shelter. While the local government may staff the shelters, more commonly, nonprofit or private-sector organizations will supervise and staff the jurisdiction's mass care facilities.⁴

In most jurisdictions, the American Red Cross (ARC) will serve as the principal organization responsible for operating mass care facilities during disasters. If ARC services are not available locally, other public or nonprofit organizations in the community may operate these facilities. These organizations may include the Salvation Army, churches, schools, or local service agencies.⁵

It is important to note that mass care shelters are temporary public living quarters that provide physical shelter, feeding and first aid. They do not provide specialized medical care.

Identification of location

Shelters should be located outside of floodplains and have sufficient structural integrity to provide physical protection from the effects of high wind, earthquake aftershocks, and radiological contamination. Relation to evacuation routes and services available in facilities are also factors to consider. Ideally, shelters sites will be pre-identified and have a completed hazard/vulnerability analysis on file.⁴

Advance information to collect for each shelter is its precise location, directions from typical access routes, occupant capacity, quantity and type of kitchens, beds available, restroom facilities, vehicle-parking capacity, stock levels of medical and sanitation supplies, food and water. These resource lists should identify the communication systems available, on-site telephone numbers, and indicate if there is an emergency power system available.⁴
Anticipated pediatric volume

Although subject to wide variation depending upon socioeconomic factors and the nature of the disaster, approximately eighty percent of evacuees will seek shelter with friends or relatives rather than go to an established mass care facility. Thus, about twenty percent of evacuees will seek public shelters. In the United States 21% of the population is under age 15, and 7% is under age 5. Thus, the expected pediatric volume in shelters will be four percent of the evacuated population.

When calculating shelter capacity during advanced planning, include any space that evacuees could feasibly use as sleeping space. For temporary evacuation shelters, calculate capacity by allocating 15 to 20 square feet per person. For general shelters, plan for 40 to 60 square feet per person.

Physical layout and activities

Emergency personnel establishing a shelter that will serve children should consider several factors. These include:

- recreation – assess available resources within the shelter for keeping clients entertained and occupied;
- availability of video, music and recreational items (ensure the appropriateness of the materials in terms of age range, language, etc.);
- plan to return any equipment used for recreational purposes to the facility or partner who provided it when no longer needed;
- establish a schedule for recreational activities;
- identify space that can be used as dedicated areas for recreation and childcare, and clearly identify these areas;
- internet access to send and receive welfare messages;
- childcare – pediatric occupants of the shelter may need childcare if parents or guardians must return to work while still residing in the shelter. The shelter supervisor should advise the Mass Care Coordinator in the EOC of the need for childcare services; and
- evaluate the need to pack lunches for children returning to school.

- Give special attention to the selection of individuals that will be working with children. These individuals should be credentialed employees or volunteers of an existing organization. Monitor the childcare program to ensure that activities are both appropriate and serve the interests of the clients. Direct childcare staff to keep a log of clients served. The log should include the following:

- the names of the children and their guardians,
- the ages of the children, and
- the days and times that the services were utilized.
Staffing

The Shelter Supervisor is responsible for providing supervision and administrative support for all actions within the shelter. This person’s responsibilities include providing resources to meet the needs of shelter occupants.

Shelters should have a law enforcement presence to provide security and traffic control. Law enforcement officers may also provide an alternative communications link between the mass care facility and the EOC through land mobile radios.

Public Works agencies should be involved with shelter operations to ensure maintenance of power, water supply, and sanitary services at mass care facilities during emergency conditions.

The National Resource Typing System has established Shelter Management Teams that are available to assist in mass care (see Table 1).

CFOC Standard (1992): ST 002—Child/staff ratios for centers and large family child care homes shall be maintained as follows during all hours of operation:

<table>
<thead>
<tr>
<th>Age</th>
<th>Child-staff ratio</th>
<th>Maximum group size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth-12 months</td>
<td>3:1</td>
<td>6</td>
</tr>
<tr>
<td>13-24 months</td>
<td>3:1</td>
<td>6</td>
</tr>
<tr>
<td>25-30 months</td>
<td>4:1</td>
<td>8</td>
</tr>
<tr>
<td>31-35 months</td>
<td>5:1</td>
<td>10</td>
</tr>
<tr>
<td>3 year olds</td>
<td>7:1</td>
<td>14</td>
</tr>
<tr>
<td>4 year olds</td>
<td>8:1</td>
<td>16</td>
</tr>
<tr>
<td>5 year olds</td>
<td>8:1</td>
<td>16</td>
</tr>
<tr>
<td>6-8 year olds</td>
<td>10:1</td>
<td>20</td>
</tr>
<tr>
<td>9-12 year olds</td>
<td>12:1</td>
<td>24</td>
</tr>
</tbody>
</table>

When there are mixed age groups in the same room, the child/staff ratio and group size shall be consistent with the age of the majority of the children when no infants or toddlers are in
the mixed age group. When infants or toddlers are in the mixed age group, the child/staff ratio and group size for infants and toddlers shall be maintained.

**Food - age appropriate**

Encourage evacuees coming to shelters to bring food with them. Since this may not occur, plan for providing feeding in shelters. For most emergencies, plan for three to five days of meals with no outside assistance. One simple formula for determining the initial number of meals is to multiple the projected shelter population by five. As a very rough guide, consider that 1% of the shelter population, or about 0.25% of all evacuees will require infant formula while in shelters.

Feeding Methods:

- Fast Food
- Distribute pre-prepared and packaged meals – Meals-Ready-to-Eat (MREs), HeaterMeals® or other similar items
- Catered meals
- School meals prepared by school cafeteria staff
- Church or community groups and kitchens

Shelter Supervisors should plan for one gallon of water per evacuee per day. If the emergency interrupts the local potable water supply, plan to have a three-day supply, or three gallons of potable water per occupant.

**Sleeping accommodations – age appropriate**

While provision for separating people of opposite genders is appropriate, do not separate children from their families. Obtain sufficient blankets to provide two per occupant. Many evacuees may be able to sleep on the floor if necessary, but a minimum of one cot for every ten evacuees should provide for those who cannot sleep on the floor.

**Sanitation, Hygiene**

Managers should assure that there is a minimum of one toilet for every 40 occupants in the shelter. Count only those facilities that will be accessible to shelter residents and shelter staff. Make up deficits with portable toilets. There should be one sink for every two toilets. An ideal shelter will also have one shower for every forty residents.

Infants and toddlers require frequent diaper changing. For infants, their diapers need to be checked for wetness and feces hourly, visually inspected at least every two hours, and whenever the child indicates discomfort or exhibits behavior that suggests a soiled or wet diaper. Diapers should be changed when they are found to be wet or soiled. A sufficient supply of diapers as well as a changing area with gloves and material to clean the surface and the hands of the care giver / shelter staff after diaper changing should be available. Sufficient supply of diapers should be available - infants should have approximately 12 diapers per child per day.
Safety

Despite the existence of an emergency, shelters are not exempt from fire and life safety or building codes. Protection of shelter staff should fall under guidelines established by state and federal agencies such as the Occupational Safety and Health Administration. Failure to comply with safety standards may place individuals at unnecessary risk. Regulatory agencies may issue citations that carry significant penalties. In addition, despite the existence of a disaster, organizations and staff that operate a shelter are not immune from civil liability should someone become ill or injured because of unsafe conditions in the shelter. Please see the table for a list of safety, health and security considerations in shelter operation.

Some facilities that appear to be suitable for sheltering might not meet fire codes based on building capacity. Shelter supervisors should contact the local fire department to ensure compliance.

Safety issues are an important consideration for children in a shelter. A report from the experience in a shelter set up at a military camp (Camp Gruber) for children evacuated after hurricane Katrina, published in Prehospital and Disaster Medicine, describes practical recommendations to improve the safety environment in shelters for children.8

Hazards identified in the shelter included those in the table below. A description of the safety hazard, the potential risk, and solution are listed.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Potential Risk</th>
<th>Safety Action Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals left near children</td>
<td>Poisoning</td>
<td>Removal</td>
</tr>
<tr>
<td>Small hard food, objects</td>
<td>Choking in infants toddlers</td>
<td>Food removed from child area</td>
</tr>
<tr>
<td>Open electric outlets</td>
<td>Electrocution</td>
<td>Covered outlet with safety cap</td>
</tr>
<tr>
<td>Missing Smoke Detector</td>
<td>Fire, inhalation, suffocation</td>
<td>Place Smoke Detectors in Shelter Kitchen / Sleeping Area</td>
</tr>
<tr>
<td>Windows</td>
<td>Falls</td>
<td>Window guards</td>
</tr>
<tr>
<td>Stair wells</td>
<td>Falls</td>
<td>Gate stair well</td>
</tr>
<tr>
<td>Open water tubs, buckets</td>
<td>Drowning</td>
<td>Remove open water sources</td>
</tr>
<tr>
<td>Fire extinguishers accessible</td>
<td>Poisoning, Inhalation</td>
<td>Fire Department Assessment</td>
</tr>
<tr>
<td>Biking and skateboarding</td>
<td>Head trauma</td>
<td>Provide helmets to children</td>
</tr>
<tr>
<td>without helmets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kids in cars without car seats</td>
<td>MV crash injury</td>
<td>Provide child car and booster seats</td>
</tr>
<tr>
<td>Infants toddlers sleeping in</td>
<td>Risk of choking</td>
<td>Provide cribs, mats on floor near cot</td>
</tr>
<tr>
<td>cots, with adults</td>
<td>Risk of fall from cot</td>
<td></td>
</tr>
</tbody>
</table>

The types of hazards, their identification, and safety actions taken to eliminate these hazards are familiar to any one who routinely counsels parents on child safety.
Shelters are likely to be set up in environments that have not been screened for hazards to children, nor modified to eliminate these risks. Therefore an important part of shelter preparation and maintenance is a child safety analysis, and removal of items or modification of the environment, or addition of safety devices to improve the safety for children and adults.
**Equipment / Disposable Supplies**

Shelter supervisors should up-channel requests for equipment and supplies to the Mass Care Coordinator in the EOC.4

**Shelter supervisor Kit**

100 Disaster Shelter Registration forms
20 Temporary Name Badges and holders

**Office Supplies**

12 ballpoint pens
1 package of 3”x5” cards
2 clipboards
4 paper tablets
2 staplers
1 box of staples
2 boxes of paper clips
1 manual hole punch
2 large permanent markers
1 box of thumbtacks
2 rolls of masking tape
1 role of scotch tape
1 package of rubber bans
1 pair of scissors
1 box of file folders
1 pad of easel paper
1 3-ring binder with tab dividers
1 whistle

1 roll of orange or yellow surveyor’s tape
1 box of trash bags
2 rolls of paper towels
1 bottle of all-purpose cleaner
1 flashlight
1 electric lantern
flashlight batteries
lantern batteries
1 battery-operated radio
1 pkg. of disposable diapers
1 box of sanitary napkins
2 boxes of facial tissue
6 rolls of toilet tissue
1 package of antiseptic pre-moistened towelettes (40)3

**Baby and Infant Support Supplies**

Plan for sufficient diapers (in a variety of sizes) and wipes for 1% of the total number of evacuees or 4% of the population in each shelter. Diaper changing tables should also be part of the shelter’s equipment. A plan for storage and disposal of soiled diapers is important.

**Identification and Tracking**

Shelters should follow guidance given in local emergency plans for registering shelter occupants. Minimum data elements include full name and pre-disaster address and
telephone number for each occupant. Record the evacuee’s post-disaster address and phone upon final departure.

The shelter supervisor should determine the reporting periods established by the EOC and provide reports as required. Common data elements include the current shelter population; the number of new individuals registered in the period; the number of registrations to date; the number of meals served in the period; the number of meals to date; the number of snacks in the period and to date.\(^3\)

### Reunification

An important task for shelter operations is to assist with the reunification of families and friends. The Safe and Well Website is a public website that allows those affected by a disaster to post standard messages about their well-being. Concerned family members and loved ones anywhere can search for the messages posted by those who self-register.

The Safe and Well Website is publicly available via the internet at [https://disastersafe.redcross.org/](https://disastersafe.redcross.org/). When using the Safe and Well Website, clients must read and agree to the Privacy Statement. Clients must accept and agree to the Privacy Statement terms in order to complete the “Register” or “Search” functions on the website. Children under the age of 13 should not enter personal information into this website without adult supervision.

In order to register on the Safe and Well Website:

- The individual must complete the “List Myself as Safe and Well” form, ensuring that the information provided is complete and accurate.
- The individual should check that at a minimum the required fields are completed, including choosing at least one “Safe and Well” Message.
- The individual must click the button indicating that they agree to the Privacy Statement terms.
- A registration may be “updated” by creating a new entry at a later time.
- Additional referrals are available on the “Service Partners” page, such as the Contact Loved Ones voice messaging service (www.contactlovedones.com).
- To search the website for missing family members:
  - The user completes the “Search” template, by entering a last name and EITHER a phone number OR an address for the person they are seeking.
  - The user ensures that the required information is complete and accurate.
  - The user must click the button indicating that they agree to the Privacy Statement terms.
  - Any matching result(s) will be displayed with the name, date and time that the registration was created and the “Safe and Well” messages were posted.

### Closing the shelter

It is always preferable to give 48-hour advance notice of a site closure if possible. However, situations occur where this is not economically or operationally practical. If officials allow residents access to their homes, shelter populations may rapidly drop to zero. It is not
reasonable to commit staff, vehicles, personnel and resources, just to allow posting of a notice.

If a shelter unexpectedly becomes empty, post a notice on the door with a message indicating a telephone number people can call if they need shelter. List all numbers that individuals may need to call for assistance, including the local American Red Cross chapter. The Mass Care Coordinator should keep the shelter on stand-by, but not staff it, for 24 hours prior to releasing the facility.

**Tables and Figures**

1. **Shelter Management Team**

<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>Mass Care (ESF #6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATEGORY</td>
<td>Kind: Team</td>
</tr>
<tr>
<td>MINIMUM CAPABILITIES</td>
<td>TYPE I</td>
</tr>
<tr>
<td>Personnel</td>
<td>Shelter Supervisor</td>
</tr>
<tr>
<td>Personnel</td>
<td>Medical Services Manager</td>
</tr>
<tr>
<td>Equipment</td>
<td>Operations Manager (water, sanitation, power, structure)</td>
</tr>
<tr>
<td>Vehicle</td>
<td>Food Services Manager</td>
</tr>
<tr>
<td>Supply</td>
<td>Exposure Control Monitor (depends on type of event)</td>
</tr>
</tbody>
</table>

**Comments:** Number Determined by Size of Shelter Operations

The Shelter Management Team provides the managerial and operational support for a shelter used to house, feed, cool, and provide a safe and secure environment for individuals and families. Responsibilities of the team include: conducting an initial walkthrough; identifying potential sheltering options; coordinating with the Mass Care Coordinator; ensuring the availability of adequate care, food, sanitation, and first aid; selecting and training personnel to perform operational tasks; monitoring safety and security; decontaminating the facility; establishing exposure control and monitoring; monitoring overpressure and filtration systems; performing post-event response/assistance; and directing egress.

2. **Resources Required**

**Per occupant**

- 40-60 square feet
- Two blankets
- Five meals
- Three gallons of water
- One toilet per 40 occupants
- One sink per 80 occupants
- One shower per 40 occupants

**Shelf-stable Meals:**

Shelf-stable meals and meals-ready-to-eat (MREs) have a longer shelf life, but require ample storage space and monitoring in order to ensure freshness. There are many vendors of this type of meal including:

AlpineAire Foods - [www.aa-foods.com](http://www.aa-foods.com)
APack Ready Meal - www.ameriqual.com
Chef 5 Minute Meals - www.chef5minutemeals.com
GA Foods/Sunmeadow - www.sunmeadow.net
HeaterMeals - www.heatermeals.com
La Briute (kosher) - labriutemeals.com/main.htm
Marketrend – www.marketrend.com
Traditions Meal Solutions - www.traditionsi.com
3. **Safety, Health and Security Considerations**

<table>
<thead>
<tr>
<th>Safety</th>
<th>Health</th>
<th>Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slips, trips and falls</td>
<td>Biological/chemical exposures</td>
<td>Check-in/check-out</td>
</tr>
<tr>
<td>Musculoskeletal injuries</td>
<td>Communicable diseases/infections</td>
<td>Safe driving/commuting</td>
</tr>
<tr>
<td>Electrical hazards</td>
<td>Blood borne pathogens</td>
<td>Criminal acts</td>
</tr>
<tr>
<td>Sharp materials</td>
<td>Sleep/rest cycle disruption</td>
<td>Emergency evacuation</td>
</tr>
<tr>
<td>Animal/insect bites/stings</td>
<td>Traumatic stress</td>
<td>Violence in the workplace</td>
</tr>
<tr>
<td>Heat/cold stress</td>
<td>Food and water contamination</td>
<td></td>
</tr>
<tr>
<td>Fire hazards</td>
<td>Aggravation of pre-existing health conditions</td>
<td></td>
</tr>
<tr>
<td>Generator fumes (carbon monoxide)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


4. **Fire and Life Safety Checklist**

- Does the facility have inspected fire extinguishers? □ Yes □ No
- Does the facility have functional fire sprinklers? □ Yes □ No
- Does the facility have a fire alarm? □ Yes □ No
  - If yes, is it (one or both): □ Manual (pull-down) □ Automatic
  - Does the fire alarm directly alert the fire department? □ Yes □ No
- Comments from fire department, if available:
<table>
<thead>
<tr>
<th>Healthy Children</th>
<th>0-6 months</th>
<th>6 months to 1 year</th>
<th>1 to 2 years</th>
<th>2 years and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>These children are breast fed or formula fed by bottle only.</td>
<td>6-9 months - baby cereal, jarred baby food or mashed table food is appropriate - along with formula or breast milk</td>
<td>This age group eats table food. Young children will need soft bite sized foods. Avoid foods that can cause choking such as hot dogs, grapes, chunks of meat unless cut in pea size pieces.</td>
<td>This age group eats table food. Young children will need finger foods. Avoid foods that can cause choking such as hot dogs, grapes, for youngest children.</td>
<td></td>
</tr>
<tr>
<td>Comments: Some breast fed children may not immediately take bottle-feeding. Continue to feed; eventually the child will feed from the bottle.</td>
<td>9-12 months - soft, bite sized pieces of foods, i.e. vegetables, mashed potatoes, and meats - along with formula or breast milk</td>
<td>Hydration: Water, Pedialyte</td>
<td>Hydration: Water, Pedialyte</td>
<td></td>
</tr>
<tr>
<td>Recommendation: Ready-to-feed formula is preferred since it is immediately ready for use and requires no refrigeration or preparation. However, powdered baby formula may be used as well. Powdered formula will have a longer shelf life.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Children With Special Needs

**Patients with feeding tubes:** There are (3) types of tube feeding: Nasogastric (N/G), Orogastric, and Gastrostomy (G/T). The first two are used for acute patients; the third is used for chronic patients.

**N/G and O/G Tube:** Used for both nasal and orogastric feedings and are temporary measures, mostly used in Pediatric Emergency Rooms or Pediatric In-Patients areas for acute feeding issues, gastric decompression, and/or delivery of oral medications such as activated charcoal.

**G/T Tube:** Used with a 60cc syringe, catheter tip and is used with a bolus continuous feed or pump.

**Infants (0-12 months):** Infant formula should be used through the tube.

12 months to 18 years of age: Pediatric formulas should be used, *i.e.* Resource Just for Kids, PediaSure or Nutren Jr. For adolescents, based on clinical judgment adult enteral product may be appropriate.

**Hydration:** Tap or bottled water.

**Comments:**

The same feeding pump used for adults can also be used to feed children

Use saline water to clean the area where the feeding tube is inserted into the patient.

Change feeding bags every 8 hours and clean prior to adding more formula.

## Diabetic Children

The nutritional needs of this group will be determined by the patient’s body weight and insulin requirements.

**Recommendation:** Patients may require between meal snacks to control blood glucose.

<table>
<thead>
<tr>
<th>Age</th>
<th>Breakfast</th>
<th>Mid Morning</th>
<th>Lunch</th>
<th>Mid Afternoon</th>
<th>Evening</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants Birth through 3 months</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
</tr>
<tr>
<td>Infants 4 months through 7 months</td>
<td>4-8 oz formula or breast milk</td>
<td>4-8 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
<td>4-6 oz formula or breast milk</td>
</tr>
<tr>
<td>Infants 8 months through 11 months</td>
<td>6-8 oz formula or breast milk</td>
<td>2-4 oz formula, breast milk, or fruit juice</td>
<td>6-8 oz formula or breast milk</td>
<td>2-4 oz formula, breast milk, or fruit juice</td>
<td>6-8 oz formula or breast milk</td>
<td>2-4 oz formula, breast milk, or fruit juice</td>
</tr>
</tbody>
</table>

References

Chapter 8: Disaster Drills
Bonnie Arquilla DO, Marsha Treiber MPS

Introduction
Reviewing the types of exercises and drills that are possible to plan and execute will help decide what type of drill is right for your group and when to start planning a drill. It is also necessary to determine the goals and objectives that need to be established and evaluated in order to move forward.

Drills and exercises are conducted to practice skills and test procedures, to improve existing protocols, and test new ideas and new protocols. The mission statement of the Department of Homeland Security is “to lead the unified national effort to secure America; prevent and deter terrorist attacks; protect against and respond to threats and hazards to the nation; ensure safe and secure borders, welcome lawful immigrants and visitors, and promote the free-flow of commerce.”

The types of drills and exercises, and when each should be planned, is based on each groups’ needs, based on real events and based on known hazard vulnerabilities. Disaster drills are necessary because while it is hoped there will be no need to respond to a natural or man made disaster, history proves that there are many challenges in the natural environment and there will be events requiring a response. Testing systems and personnel help prepare, mitigate and respond in a more effective manner. Planning and practice is all well and good; but it is crucial to test systems and be willing to change based on exercise results. Drills are also a way to develop new working relationships.

Conducting exercises and drills prepare agencies to clarify roles and responsibilities. Resource gaps become clear while practicing for exercises and stressing systems. The exercise organizers and the drill participants will be able to judge individual performance, identify areas where additional or in-depth training may be needed. They will also be able to recommend changes. The knowledge gained from regular disaster drills will enable organizations to develop and implement an improvement plan and decide what other types of drills will be necessary.

Types of Exercises

Seminars
A seminar is an informal discussion-based exercise led by a presenter or facilitator, used to teach or orientate participants. Seminars and workshops orient participants to new or existing plans, policies, or procedures. They assess interagency capabilities or inter-jurisdictional operations. They also construct a common framework of understanding. A seminar takes place in a casual atmosphere, with minimal time constraints, and is lecture-based. Seminar participants develop new ideas, processes, or procedures. They construct a written product as a group in coordinated activities, obtain consensus, and collect or share information.
Tabletop Exercises

A tabletop exercise involves senior staff, elected or appointed officials or other key personnel in an informal group discussion centered on a hypothetical scenario. Tabletops identify strengths and shortfalls, enhance understanding of new concepts and seek to change existing attitudes and perspectives. They require an experienced facilitator. During the exercise there are in-depth discussions and slow-paced problem solving.

Games

A game is a simulation of operations using rules, data, and procedures designed to depict an actual or assumed real-life situation. Games explore the processes and consequences of decision-making, conduct "what-if" analyses of existing plans, and test existing and potential strategies. A game does not involve the use of actual resources. More often it involves two or more teams, and includes models and simulations of increasing complexity as the game progresses.

Operations-Based Exercises

Operations-Based Exercises involve deployment of resources and personnel. They are more complex than discussion-based types. The require execution of plans, policies, agreements, and procedures, as well as clarify roles and responsibilities of players. Their aim is to improve individual and team performances. Drills and both functional and full-scale exercises are included in this category.

A drill is a supervised activity that tests a specific operation or function of a single agency. The goals of a drill are to:

- Gain training on new equipment
- Test new procedures
- Practice and maintain skills
- Prepare for more complex exercises

A drill provides immediate feedback. It is realistic, but is held in an isolated environment.

A functional exercise is a single or multi-agency activity designed to evaluate capabilities and multiple functions using simulated response. The goals of a functional exercise are to:

- Evaluate management of Emergency Operations Centers, command posts, and headquarters
- Assess the adequacy of response plans and resources

A functional exercise uses simulated deployment of resources and personnel, rapid problem solving in a highly stressful environment.

A full-scale exercise is a high-stress multi-agency, multi-jurisdictional activity involving actual deployment of resources in a coordinated response, as if a real incident had occurred. The goals of a drill are to

- Assess plans and procedures under crisis conditions
- Evaluate coordinated responses under crisis conditions
A full-scale exercise involves mobilization of units, personnel, and equipment. It occurs in a stressful, realistic environment using a scripted exercise scenario.

**Before Conducting an Exercise**

**Conduct Needs Assessment /Hazard Vulnerability Analysis**

The planning team’s first duty is to develop a needs assessment. Once developed, the type of exercise that should be planned becomes evident. The best way to determine the appropriate exercise design is to assess your organization’s or jurisdiction’s capability needs.

A comprehensive exercise program will already have evaluated its organization’s capabilities. Referring to and updating that assessment is an important step whenever a new exercise is considered for development.

The needs assessment will identify what parts of the organization need to be practiced or tested:

- Functions most requiring rehearsal
- Potential exercise participants
- Existing exercise requirements and capabilities
- Plausible hazards and the priority levels of those hazards

**Create an Exercise Planning Team**

Every exercise requires an Exercise Planning Team – the core group responsible for the design, development, conduct, and evaluation of an exercise. A team consists of a Lead Planner and planning team members.

The Exercise Planning Team:

- Determines exercise objectives
- Creates the scenario
- Develops exercise documentation
- Conducts pre-exercise briefing and training sessions

Because of their high level of involvement, planning team members are ideal selections for exercise controller and evaluator positions. As a general rule, however, they do not participate as players. Planning Team Organization naturally follows Incident Command Structure (ICS).

Tasks assignments are often based on the following functions:

- Command
- Logistics
- Operations
- Administration/Finance
Plan Exercise
Develop and coordinate an exercise.
Conferences provide an opportunity for the team to:

- Define the exercise purpose and objectives.
- Develop the scenario
- Coordinate logistics.
- Track design and development progress
- Troubleshoot design or development problems

The scope, type, size, and complexity of the exercise determine the type and number of conferences the planning team decides to conduct.

Types of Planning Conferences
Five different types of planning conferences or meetings may occur during the planning process.

*Concept and Objectives (C&O) Meeting*

- Optional—may be rolled into the Initial Planning Conference (below).
- Exercise type, scope, scenario, and objectives are identified
- Official Exercise Planning Team selection occurs
- Sponsoring agency and senior officials attend

*Initial Planning Conference (IPC)*
If there is no C&O meeting, the IPC has the same characteristics, as well as the following:

- Refines exercise scope, scenario, and objectives
- Solidifies exercise timeline and task list
- Sets task assignments for planning team members

*Mid-Term Planning Conference (MPC)*

- Settles outstanding logistical or organization issues
- Site walkthrough is conducted
- Usually only held for operations-based exercises
Master Scenario Events List (MSEL) Conference

- Develops (or continues developing) scenario injects for exercise conduct
- Usually only held for operations-based exercises

Final Planning Conference (FPC)

- Final drafts of exercise materials are completed
- Logistics and procedures for exercise conduct are finalized
- Last opportunity to settle outstanding issues

Planning and Managing an Exercise

An exercise program provides the administration, supporting resources, and strategic goals for an organization’s exercise efforts. It involves developing and executing an exercise program, including:

- Multiyear training and exercise program planning
- Budgeting and grant writing
- Planning and executing individual exercises
- Tracking improvements

Exercise program management can vary in size and scope, with staff members responsible for all or parts of the duties.

Exercise Project Management

Project managers are responsible for the design, development, and execution of a specific exercise, followed by evaluation and improvement planning. Good project management involves:

- Developing a project management timeline
- Establishing project milestones
- Identifying the exercise planning team
- Scheduling planning conferences

These tasks are the foundation of every exercise - without them, other tasks and stages of the exercise planning cycle could not happen.

Multiyear Training & Exercise Planning

The Multiyear Training & Exercise Plan is essential to managing an exercise program. The plan is a document that outlines a program’s long-term strategy for building capabilities through exercises and training. A multiyear training & exercise plan:
• Takes stock of current program plans and capabilities
• Lays out long-term program goals and objectives
• Develops a mix of exercises to meet goals and objectives
• Determines what training is needed as a prerequisite to planned exercises
• Sets a multiyear schedule of exercises and training events

Program managers use the Multiyear Training and Exercise Schedule to:
• Avoid duplicating their efforts
• Combine exercises and ensure the exercises don't conflict
• Combine training and ensure training does not conflict
• Optimize and combine funding where possible
• Prevent "over" training and exercising

**Design and Development**

Design and development helps to set the exercise into motion. Design is the framework of an exercise, and development is the building of that exercise.

**Step One:** Develop a design by asking these questions:

• What are the needs to be assessed?
• What is the scope of the exercise?
• What is the purpose? (must be written out)
• What are the exercise objectives? (this is a list of what is to be test which will best evaluate the purpose and test each goal)
• What is the exercise scenario?

**Step Two:** Development

• Create exercise documentation.
• Arrange logistics, actors, and safety.
• Coordinate participants and media.
• Execute other supporting planning tasks (e.g., training controllers, evaluators, and exercise staff).

The **Purpose Statement** is based on the Needs Assessment which should be clearly defined in writing. The purpose of an exercise should be captured in a simple phrase that communicates the intent of the exercise. It does not describe in detail how the intent will be achieved. This is a key element to a successful exercise.

An **Objective** is a description of the performance you expect from participants. Generally, the number of exercise objectives should be limited in order to enable timely execution, facilitate design of a reasonable scenario, and promote successful completion of the exercise purpose.
Use the **SMART Acronym** to define objectives.

- **S**imple—Don’t try to cover too broad an area.
- **M**easurable—Ensure evaluators can determine whether the objective was achieved.
- **A**chievable—The objective should not be too difficult to achieve.
- **R**ealistic—The objective should present a realistic expectation of the situation.
- **T**ask-oriented—The objective should focus on a behavior or procedure.

A **Scenario** is the storyline that drives an exercise. Its three basic elements are general context or comprehensive story, technical details of the story’s conditions and events, and conditions for assessing/demonstrating capabilities. Scenarios should be threat-based and performance-based, realistic, and challenging. However, they should not be so demanding that participants become overwhelmed. In addition to stress, Players must feel the challenges are achievable. A scenario should involve the participants, the threat, and the area identified in the scope.

### Exercise Documentation

A **Situation Manual** (SITMAN) is the participant handbook for discussion-based exercises. It provides background information on the scope, includes a schedule, and identifies objectives for the exercise. It also can present the scenario narrative for participant discussions during the exercise.

The **Exercise Plan** (EXPLAN) is the participant handbook for operations-based exercises. The EXPLAN provides controllers, evaluators, players, and observers with information such as the exercise purpose, scope, objectives and logistical information.

Controller Evaluator (C/E) Handbooks supplement EXPLANs for operations-based exercises. The C/E Handbook contains more detailed information. It is not for the players of the exercise. Scenario guide defines the roles and responsibilities of controllers and evaluators.

The **Master Scenario Events List** (MSEL) contains a chronological listing of the events and injects that drive operations-based exercise play. Exercise injects are bits of scenario-specific information provided to participants to enhance the value of the exercise experience.

**Exercise Evaluation Guides** (EEGs) provide evaluators with a checklist of critical tasks to be completed by players during an exercise. EEGs contain information to be discussed by participants based on the scenario, space to record evaluator observations, and questions to consider after the exercise.

### Responsibilities of Exercise Participants and Personnel

Discussion-based exercise personnel include:

- **Presenters** - Deliver the exercise presentation.
- **Facilitators/Moderators** - Lead group discussion
- **Controllers** - Interpret rules and provide players with information
Evaluators - Observe and collect exercise data
Players - Discuss issues based on professional knowledge
Observers/VIPs - View but do not participate in exercise
The positions of presenters, facilitators/moderators, and controllers may be combined depending on the size and scope of the exercise.

**Controllers and evaluators** have two primary responsibilities: Keep an exercise on track and assess its performance.
Controllers plan and manage exercise play, set up and operate the exercise incident site, sometimes simulate non-participating organizations, and participate in post-exercise meetings and critiques.
Evaluators do not interfere with exercise flow. They track action relative to evaluation objectives, identify any resolved and unresolved issues, and help analyze the exercise results. They participate in post-exercise meetings and critiques.
NOTE: Because of their familiarity with the exercise, planning team members make excellent controllers and evaluators.

**Site Setup**
Site Setup is done by the planning team at least a day before conducting an operational exercise. Often an outdoor venue is used, which should be pre-determined during the planning phase. Any necessary permits should be obtained in a timely manner. The site setup may include:

- Response Route - routes to the simulated incident
- Response Area - location of exercise activities
- Assembly Area - location of deployable resources participating in the exercise
- Observer/Media Area - designated viewing area
- Simulation Cell - location generating scenario injects
- Registration – to ensure only authorized personnel are allowed on scene
- Parking

**Briefings**
All briefings must be carefully planned. A *Pre-Exercise Briefing* serves to train and/or inform exercise participants and provide safety information to all personnel. They are different for controllers, evaluators, players, and actors based on the exercise documents. This briefing is used to explain exercise play rules (which vary for each exercise).
During a **Post-Exercise Debriefing** participant feedback forms are reviewed. A “**Hot Wash**” occurs immediately following a tabletop exercise to review key decisions made during the exercise and allows the participants the opportunity to provide immediate feedback. A hot wash:

- Enables the moderator to capture thoughts, decisions made and other events while they remain fresh in the participants’ minds and to describe what was learned
- To determine any issues or concerns in the Emergency Management Plan
- To identify emergency preparedness gaps and proposed areas of improvement and next steps for modifying the Emergency Management Plan

**Evaluation Process**

There are eight Homeland Security Exercise Evaluation Process (HSEEP) steps in the evaluation process (as defined and mandated by Homeland Security):

1. Plan and organize the evaluation
2. Observe the exercise and collect data
3. Analyze data
4. Develop the draft After Action Report (AAR)
5. Conduct an After Action Conference
6. Identify improvements to be implemented
7. Finalize the AAR and Improvement Plan (IP)
8. Track implementation

The **Exercise Evaluation Guide** (EEG) is a key document used by evaluators during the exercise. EEGs provide structured evaluation measures of participant conduct, listing critical activities and tasks to be completed during an exercise. They tell evaluators what they should expect to see, give them space to record observations, and list questions to address after the exercise as a first step in the analysis process.

An EEG might include such questions as:

- Were roles and responsibilities of the various government agencies and private organizations clear?
- How were various decisions made? Who had authority?
- What information about the scenario, the weapon, the victims, and the risks to responders and the public was collected in the course of the exercise?

The **Exercise Evaluation** assesses how well the exercise objectives were achieved. It also identifies opportunities for improvement. Evaluators accomplish this by observing the exercise and collecting supporting data, gauging performance against expected outcomes, and determining what changes are needed to ensure desired outcomes. Evaluation is the yardstick by which an organization measures its capabilities. Good evaluations result in suggestions for filling and bridging capability gaps or making needed improvements.
The **Evaluation Methodology** of the Department of Homeland Security assesses exercise performance at three levels. The **Task Level** evaluates the ability of individual players or teams to perform a required task during an exercise. The **Organization/Discipline/Function Level** assesses the ability of an organization (e.g., Jonesville EMA), discipline (e.g., law enforcement), or function (e.g., HazMat response) to perform its role in responding to an event. The **Mission Level** reviews the ability of the intergovernmental community as a whole (across disciplines and jurisdictions) to achieve expected outcomes in responding to an event.

The main instrument of exercise evaluation is the **After Action Report** (AAR) which often is prepared by the members of the planning team and evaluation team. The After Action Report (AAR) provides participant officials with feedback on the exercise’s results and suggests recommendations for improvement. AARs should be prepared after every type of exercise. They should summarize what happened during the exercise, provide feedback to participants on their performance, and recommend improvements for better preparedness.

<table>
<thead>
<tr>
<th>Recommended DHS (HSEEP) AAR Format</th>
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</thead>
<tbody>
<tr>
<td><strong>Executive Summary</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Exercise Overview</strong></td>
<td>Includes background information: participating organizations, exercise conduct date and time, location, exercise type, hazard, evaluation methodology.</td>
</tr>
<tr>
<td><strong>Exercise Goals and Objectives</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Exercise Events Synopsis</strong></td>
<td>Chronicological synopsis of major events and actions.</td>
</tr>
<tr>
<td><strong>Analysis of Mission Outcomes</strong></td>
<td>Summarizes how the performance or nonperformance of tasks and interactions affected achievement of the mission outcomes.</td>
</tr>
<tr>
<td><strong>Analysis of Critical Task Performance</strong></td>
<td>Summarizes and addresses issues regarding each task in terms of consequences, analysis, recommendations, and improvement actions.</td>
</tr>
<tr>
<td><strong>Conclusion</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Appendix: Improvement Plan Matrix</strong></td>
<td>Provides a task list of recommendations, due dates, and responsible organizations.</td>
</tr>
</tbody>
</table>

**Improvement Planning Process**

Improvement planning completes the cycle of preparedness. Those needs identified in the AAR become the next step for future exercises. They help define an exercise program’s direction and schedule. They also help develop a strategy for improving training, purchasing equipment and creating policy, as well as scenarios and objectives for future exercises. Exercises help assess and improve performance. Evaluations identify what areas need improving. Improvement planning identifies actions designed to ensure improvements are made.
Improvement Plan

A task list and timeline of corrective actions, called the Improvement Plan (IP), is part of the AAR, which generally includes summaries and evaluations of the exercise scenario, player activities, preliminary observations, and major issues. AARs vary in size and detail, depending on the complexity of an exercise. Sources for AAR data include evaluator observation; Exercise Evaluation Guides; Hot wash, debriefing, or participant feedback forms; and plans and procedures of participant organizations.

Once recommendations and action items have been identified, organizations should ensure that each item is tracked to completion and improvements are implemented. When no resources are available, alternative short and long-term solutions such as mutual aid agreements should be considered.

References

Chapter 9: Topical Decontamination of Children

Michael Shannon MD, Sarita Chung MD

Relevant Epidemiology

Currently, we live in an age where there is a real risk of terrorism with the release of biological, chemical or radioactive agents. Additionally, the constant transport of hazardous materials (trains, airplanes) can result in unintentional hazardous materials (HAZMAT) incidents; these hazardous substances can even be released intentionally as “weapons of opportunity”. Even schools and children can be targeted as tragically displayed in the Beslan school hostage crisis of 2004.

Incidents such as those described above can lead to toxic substances landing on the skin and clothes of victims. In such a case it is necessary to quickly remove the toxins in order to reduce the victim’s further exposure and to assure that health care providers are not themselves harmed by their exposure to the toxin(s). The 1995 sarin attacks in Japan vividly demonstrated the importance of decontaminating victims before they are treated by first responders and first receivers. In that incident, health care providers were sickened by the toxic agent because they began care for victims prior to decontamination. Many health care workers were unable to provide care, ultimately becoming victims themselves (Table 1).1

Conditions Requiring Decontamination

There is a broad range of substances that can contaminate the skin of children after intentional (terrorist) or unintentional incidents. General categories of these substances, prototypical agents, and their associated clinical manifestations are:

Chemical and Biological Agents

Nerve Agents (sarin, soman, malathion): Signs of intoxication: central nervous system (weakness, stupor, coma), neuromuscular (weakness, fasciulation), and respiratory distress (bronchospasm, bronchorrhea).

Vesicants (mustard, ammonia, chlorine): Signs of intoxication: severe eye, skin and airway irritation, blistering, respiratory distress

Choking Agents (phosgene, chlorine): Signs of intoxication: respiratory distress (cough, dyspnea, bronchospasm, pulmonary edema)

Cyanogens (cyanide, sodium azide): Signs of intoxication: dyspnea, central nervous system depression, metabolic acidosis

Industrial Solvents (gasoline, oil, and other petroleum distillates): Signs of intoxication: respiratory distress, skin irritation, central nervous system depression

Biologica (anthrax spores): Signs of intoxication: respiratory distress, widened mediastinum on chest x-ray if spores are inhaled; skin findings if nonintact skin is exposed2-4
Radiation

There are three general categories of radiation with differing mechanisms of injury:

- **Ionizing radiation** transfers energy to living cells, resulting in direct tissue injury.
- **Electromagnetic radiation** (e.g., gamma rays and x rays) pass through tissues irradiating cells resulting in tissue damage. These rays do not leave behind radioactivity and typically do not require topical decontamination.
- **Particle radiation** (e.g., α- particles, β- particles, neutrons). Alpha particles do not penetrate the skin. In high doses, beta particles can penetrate the epithelium, producing skin damage. Neutrons are an uncommon type of radiation; their penetration is highly destructive to tissues.

Not all forms of radiation lead to contamination of the skin and clothes; many agents can be inhaled or ingested (incorporation), making topical decontamination needless. External contamination requiring topical decontamination occurs when particles fall on the skin. For example, radioactive dispersal devices (RDDs, “dirty bombs”) are conventional explosives placed near radioactive material to disperse radiation. The particles released from an RDD can result in significant external contamination. Even so, radioactive contaminants pose little or no risk to the properly garbed health care professional. Radioactive particles (both alpha and beta) will not penetrate the gowns or gloves commonly used as personal protective equipment (PPE) for the “standard precautions” taken for any patient with an emergency condition. As such, while it is advisable for patient decontamination to precede resuscitation for most pediatric patients who require emergency care, decontamination should not precede resuscitative efforts for patients in extremis. These patients should be resuscitated first, followed by decontamination of both patient and provider, recognizing, again, that the risk to the properly garbed health care provider approaches zero, and will be further minimized by doffing contaminated PPE and other clothing, and washing with soap and water in a properly outfitted decontamination unit before donning fresh clothing.

**Unique Pediatric Considerations with Decontamination**

**Anatomic.** The small size of infants and young children can make safe, thorough decontamination difficult. Also, children have less subcutaneous fat than adults, placing them at risk for hypothermia.

**Physiologic.** On a per weight basis, children have a higher minute ventilation. Additionally, their short stature places them closer to the ground which potentially increases their exposure to chemicals and biological, particularly those heavier than air. The greater skin to body mass ratio of children predisposes them to increases transdermal injury from toxicants as well as an increased risk of hypothermia.

**Developmental.** The immature motor skills of children make it more difficult for them to flee. Infants and toddlers cannot decontaminate themselves, requiring greater resource utilization. Older children need special guidance during the decontamination process in order to reduce their fear and gain their cooperation for the procedure.

**Psychological.** Children are at increase risk of developing post traumatic stress disorder and enduring behavioral disturbances after being exposed to toxic agents and, potentially, to
the somewhat frightening scene of providers in personal protective environments and/or large, dark decontamination chambers.3

Decontamination Principles and Techniques

Any decontamination plan must have scalability, that is, an ability to decontaminate a few children (as few as two or three) as well a large number (>50). Prehospital providers and health care facilities should generally consider a two-part plan. Also, while removal of clothing accounts for up to 90% of topical decontamination, showers are an integral part of any plan, necessary to wash toxic materials from the skin. Showers should have temperature and pressure control, providing water at 37-38 degrees Celsius and 60 pounds per square inch (psi) of pressure. Consider using adjustable pressure hand held showers for infants and toddlers. In order to have an effective, all-weather decontamination plan there must also be an adaptable plan for temperatures extremes. For example, preparation for cold weather requires warmer water, heaters, and insulating blankets to prevent hypothermia. Hot weather conditions require cooler water and immediate shelter to prevent hyperthermia.

Decontamination Staging

The area where decontamination is to be performed can either be near the site of exposure, provided by prehospital personnel, or at the health care facility which received patients. Typically, hospital decontamination staging areas are placed near the emergency department in order to provide close access to life-saving equipment after showering has been completed.

Personal protective equipment (PPE) is an essential part of decontamination. All health care personnel who will provide initial care for contaminated victims must wear proper equipment to avoid becoming exposed. There are four categories of PPE ranging from Class A (fully protective, including self-contained breathing apparatus) to Class D, consisting of gowns, gloves and masks. A complete discussion of each class and their use is beyond the scope of this chapter. In general, however, Class C PPE, which includes chemical-resistant gowns and gloves and a respirator (typically a so-called N-95) or personal power-assisted respirator (PAPR).7

Decontamination Areas have a characteristic configuration, designed to prevent the contamination of unaffected areas. These zones, outlined below, should be clearly delineated; they should not be breached. Police and other security officers should be stationed at the decontamination staging area so that victim flow is one-way, preventing cross contamination.

Hot Zone: This is the area where all exposed patients should be placed. All healthcare workers must be in protective gear. Designate a triage coordinator to direct sicker victims who most urgently need medical attention. Communication between health care personnel is difficult through protective gear; consider developing large posters/pictures to show victims what will need to be done. Alternate methods for communication include the use of prerecorded messages or a video that instructs victims (in different languages that are common in that region) on what to expect and do.

Warm Zone: This zone contains the area where the actual process of decontamination occurs. Victims should first disrobe. Screen barriers should be used to help with personal modesty. For young children, segregation by gender is unnecessary. However, school age children and adolescents should be separated into separate lines for males and females. All clothing and
items must be gathered and labeled as evidence for law enforcement officials. Victims should be led through the showers by health care workers in protective gear. Families should be encouraged to stay together during this process.

**Clean (Cold) Zone:** The cold area, placed immediately after the shower, is the area where decontaminated victims are received and transported for medical care. Clothing and blankets should be provided for personal modesty and prevent hypothermia. Victims should be triaged according to need for medical care and then be transported to the appropriate medical care facilities.

### Age-based Issues in Decontamination

**Infants and Toddlers** will be slippery when wet and can not be expected to cooperate for the entirety of decontamination. Consider placing infants in a large container or stretcher so that they will not be dropped. Ideally, the container should be porous to allow for drainage of water during the shower, e.g., a bassinet or laundry basket. Special attention should be paid to keeping the airway patent during the shower.

**Preschoolers** can be frightened by the decontamination process, refusing to participate or even developing tantrums. To reduce this risk, families should be brought into the decontamination area together. Parents can also assist in washing their children although they should not be solely responsible for decontaminating the child. If possible, enlist the aid of other adults who are familiar with the child, e.g., a teacher in the case of a school-based event.

**School Age Children and Adolescents** may not want to disrobe in public and may adamantly refuse decontamination due to fear of embarrassment. It is therefore essential to have partitions (screen or curtain) in place to maintain personal modesty.

**Children with Special Healthcare Needs** pose a particular challenge to decontamination. Fifteen to twenty percent of the pediatric population consists of children with special health care needs, including those who are technology-dependent (i.e., those who require motorized wheelchairs, ventilators, or continuous monitoring). Non-ambulatory children may require decontamination on a stretcher or in a wheelchair. For children who are ventilator-dependent, manual ventilation will be necessary during decontamination since ventilators are not manufactured to be waterproof. Decontamination personnel must pay careful attention to the airway of children with tracheostomies. Children may also have central IV lines, pumps, and feeding tubes that can not be detached from the body. Any external equipment should be considered contaminated. If it cannot be cleansed with water or otherwise effectively decontaminated, it should be discarded.

### Pitfalls in Management

There are many challenges to the decontamination of children. For example, communication is a significant problem for personnel wearing personal protective equipment. The thick, chemical resistant gloves that are part of decontamination effectively eliminate manual dexterity, making it difficult for personnel to handle infants or provide medical treatment, e.g., IV insertion during the decontamination process. These factors can prolong decontamination, resulting in important delays in definitive medical management; the
generally recommended 5-minute per victim period of decontamination can be doubled or tripled. To plan for such a situation, decontamination plans should include protocols that create a medical intervention area within the hot zone where life-saving measures are performed prior to decontamination.

**Challenges and Complications of Decontamination**

**Removal of identifiers:** Children spend 80% of their waking hours in school or activities, away from their families; disasters may therefore separate them. Infants and other preverbal children are unable to identify themselves. Removal of clothing may remove the only means of child identification. Decontamination plans should therefore include a tracking system to account for all children brought into the facility. This is particularly true after mass casualty incidents, in which there may be large numbers of children rapidly entering the health care system. Consider taking pictures (digital images) of each child, prior to their disrobing, which can be used for identification by caregivers/family members.9,10

**Hypothermia:** Children are at increased risk of developing hypothermia if attention is not paid to environmental conditions.3

**Fear and anxiety:** Children are at risk for developing significant anxiety or post traumatic stress disorder after being involved in or witnessing traumatic events. A clearer understanding of children’s needs and immediate psychosocial support are a key part of initial care in order to reduce this risk.11,12

**Personnel safety:** The personnel working in protective personal equipment can easily become overheated. It is therefore important for occupational health providers to be present to monitor the health of personnel. Strong adherence must be made to only allow personnel to work 20 minutes or less when wearing PPE. Also, personnel are at significant risk of developing anxiety or distress in their care of victims. Mental health staff should be readily available to care for providers.11

**Summary**

Decontamination continues to be a challenge in events where children are exposed. Special attention should be directed to understanding children’s anatomical, physiological, developmental and psychological differences to reduce complications. Decontamination plans should be scalable, equally effective for small as well as large numbers of children. Other pediatric issues include post decontamination care, tracking of unidentified children and mitigation of psycho-behavioral distress. A comprehensive plan for the decontamination of children should be part of every prehospital and hospital (pediatric and non-pediatric) disaster plan.

**References**


**Web Based Resources:**

AHRQ and Children’s Hospital Boston Training Video: Decontamination of Children Available at [http://www.ahrq.gov/research/decontam.htm](http://www.ahrq.gov/research/decontam.htm)


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**Table 1:** Secondary Exposure Rates by Hospital Occupational Category and Site of Care Delivery in the Sarin Tokyo Subway Attack at St. Luke’s Hospital, Japan¹

<table>
<thead>
<tr>
<th>Occupational Category</th>
<th>Nurse Assistants</th>
<th>39.3% (11/28)</th>
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</table>

¹ Indicates footnote or reference.
### 9: Decontamination

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<thead>
<tr>
<th>Role</th>
<th>Percentage</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>Nurses</td>
<td>26.5%</td>
<td>45/170</td>
</tr>
<tr>
<td>Volunteers</td>
<td>25.5%</td>
<td>14/55</td>
</tr>
<tr>
<td>Doctors</td>
<td>21.8%</td>
<td>12/55</td>
</tr>
<tr>
<td>Clerks</td>
<td>18.2%</td>
<td>12/66</td>
</tr>
</tbody>
</table>

### Site of Care

<table>
<thead>
<tr>
<th>Location</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapel</td>
<td>45.8%</td>
<td>38/83</td>
</tr>
<tr>
<td>ICU</td>
<td>38.7%</td>
<td>12/31</td>
</tr>
<tr>
<td>Outpatient Department</td>
<td>32.4%</td>
<td>34/105</td>
</tr>
<tr>
<td>Ward</td>
<td>17.7%</td>
<td>14/79</td>
</tr>
<tr>
<td>ED</td>
<td>16.7%</td>
<td>8/48</td>
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</table>
Chapter 10: Providing Psychological First Aid and Identifying Mental Health Needs in the Aftermath of a Disaster or Community Crisis

David Schonfeld MD

Introduction

Attention to distress is important in all prehospital emergency encounters.

Prehospital providers encounter children and families in stressful situations virtually every day; in many ways, stress is intrinsic to the nature of prehospital/emergency medical response. Since this may become routine for the prehospital provider, it is sometimes easy to forget that the experience for the vast majority of patients and their families remains novel and highly stressful. The following is a list of some of the reasons why understanding the impact of stress on children and their families and learning effective and efficient strategies to promote adjustment and coping of patients and their families can therefore have great benefit on a daily basis:

- Psychological distress may present as symptoms that mimic serious physical conditions – tachypnea, tachycardia, disorientation, confusion, complaints of pain, etc. may emanate from psychological factors rather than physical etiologies.
- Even if physical etiologies are the primary cause of symptoms, an overlay of psychological distress may worsen symptoms and complicate medical management. Physiologic and psychosocial factors frequently co-occur and contribute directly to the elaboration, persistence, and/or manner of manifesting symptoms.
- Individuals who are distressed have difficulty providing accurate and timely historical information, thereby impeding the evaluation and treatment process.
- Patients who are agitated are less likely to cooperate with necessary treatments and may undermine the provision of emergent care (e.g., an agitated child may refuse to keep an oxygen mask in place or resist being placed on a stretcher for transport to the hospital).

Time spent on understanding the patient’s psychological distress and implementing effective brief interventions may actually shorten the overall time for the encounter and expedite the delivery of appropriate emergency medical care. Better engagement with the patient and family, more efficient acquisition of accurate historical information and description of symptoms, time avoided on unnecessary and ineffective treatments resulting from misattribution of the cause of symptoms, and increased active participation of the patient and family in the treatment process all contribute to the ultimate time savings as well as an improvement in outcome.
Psychological First Aid in the Aftermath of a Disaster or Other Crisis

Especially in the aftermath of a disaster, prehospital providers may not only be the first responders who have an opportunity to identify psychological distress, but may in fact be the only health care professionals to identify, triage, and begin interventions to promote adjustment and coping for children and their families. All professionals and paraprofessionals that have the potential to interact with individuals after a disaster or other crisis should understand the principles of psychological first aid (PFA). PFA involves offering psycho-education and supportive services to foster effective and normative coping strategies and adjustment and to accelerate the natural healing process. The following are some basic first steps that pre-hospital providers can take:

• Establish open communication with the children and their families. Ask the children directly what they know about the disaster or crisis and explain to them in simple and direct terms the basic information about the event, without providing unnecessary elaboration or graphic detail. Then ask the children what further information they would like and encourage them to share their concerns and questions as they arise. Remember, children may have very different concerns than adults about the crisis event, their health, or the health care interventions. Many of these concerns will be based on misinformation or misunderstandings. Provide clarification and reassurance as appropriate, without providing inaccurate or false reassurance.

• Ask children and families about how they are coping as well as their personal experiences. Some children will withdraw and many will feel uncomfortable talking directly about what has happened or their personal reactions – do not force the conversations. Validate children’s reports of feelings and expressions of concern.

• Allow children to show their distress; do not try to cheer them up or encourage them to hide or mask their distress. Health care providers should feel free to demonstrate empathy, but should avoid indicating they know exactly what victims are going through (only they can know) or telling them how they ought to feel (“Many children that I take care of in emergencies are scared and upset – how are you doing?” is preferable to “You must be scared.”).

• Help children to understand the information you are providing about the evaluation and treatment process. Use simple and direct explanations, avoid jargon and unnecessary details, and invite and answer questions. Do the same for their parents/caregivers and other family members, since under stress even well educated adults will have difficulty processing medical information.

• Meet children’s basic needs for safety, food and drink, and reunification with loved ones as important first steps in meeting their mental health (and by extension their physical health) needs. Let them know that they are safe and what you are doing to keep them safe. State actions in positive terms, for example, “I am going to put this belt around your waist so you remain secure and safe in the bed as we move it into the ambulance and drive to the hospital” rather than “I am going to put this belt around your waist so if we get in a car accident you don’t go flying out the window and get even more injured.”

• Allow parents and other important caregivers and family members to remain with the children to the extent possible; guide these adults in how they can be helpful to their children and the health care team (e.g., how they can assist with distracting or calming...
the child; how they can help keep the oxygen mask in place, etc.) – providing an active and appropriate role for the parents in the evaluation and treatment process minimizes the likelihood (but does not eliminate the possibility) that their presence will be disruptive. Parents and other caregivers may refuse to be separated from their children in the aftermath of a disaster, even if they themselves are in need of emergency medical care. As a result, prehospital providers and emergency rooms should be prepared to treat families as intact units in the aftermath of a disaster or major crisis.

- To the extent possible, locate or move children in order to shield them from unnecessary additional exposure to traumatic aspects of the event; be conscious that even young children can and will overhear conversations among members of the health care team, whether related to their own medical care or the disaster or crisis event. Also be conscious if televisions or radios may be overheard.

- Help children identify supports and coping techniques that have been effective in the past for other stressors and suggest they try them now. For example, if distraction has worked in the past, consider allowing the children to listen to their MP3 player if that will not interfere with the evaluation or treatment. Suggest other coping techniques, such as talking with trusted adults, cuddling a stuffed animal, etc.

- Consider offering transitional objectives, such as something familiar and comforting from their parents/caregivers or home (e.g., their bedroom pillow or pillow case that has a familiar scent, a picture of a parent who can’t be with the child, one of the child’s stuffed animals, etc.), being careful not to take anything of significant value (monetary or personal) that would be difficult to replace.

- Psychotropic medication is rarely indicated in the immediate aftermath of a crisis and should be prescribed in consultation with a child psychiatrist or other pediatric health care provider familiar with the assessment and management of traumatized children. Attempts to use psychotropic medications immediately after an event in order to blunt the child’s awareness of what is occurring or to reduce typical reactions (e.g., crying) should be discouraged – such awareness and opportunities to express distress are required in order to understand and ultimately adjust to what has occurred.

- Specific guidelines on how to approach death notification with children can be found elsewhere.¹

Be conscious of the impact of the event and its aftermath on the members of the health care team. Children and family members are very responsive to the affective tone of the health care provider. Attempt to convey a sense of control of the situation and respond in a gentle,

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10: Psychological First Aid

Children's Reactions to Disaster and Crisis

Children's responses to a disaster or crisis situation depends to a large extent on their developmental and cognitive level, their pre-existing mental health and coping skills, their prior experiences with traumatic situations, and the resources within their families and communities for providing support and assistance. Common reactions that may be seen shortly after a disaster or other crisis that will be apparent for prehospital providers include the following:

- Increase in fears – the fears may be associated with a recurrence of the crisis event (such as a fear of the wind after a devastating hurricane) or an increase in fears characteristic of the developmental period (e.g., fear of the dark) even if unrelated to the circumstances of the particular crisis event. Remain conscious of this reaction and inquire of the child and family members about potentially frightening situations and attempt to minimize such exposures (e.g., shield the child from wind, explain why drafts do not indicate an impending storm, keep a light on inside the ambulance during transport, etc.).
- Anxiety or worries, which may include fear about separation from family and other significant individuals; this separation anxiety is often associated with fears that harm may come to themselves or those close to them if they were to be physically separated. Younger children may demonstrate an increase in clinginess. Emergency evaluations of young children who are having difficulty with separation may be best accomplished, when possible, while they are being held by a parent or caregiver or least able to hold hands.
- Difficulty concentrating or appearing confused or disoriented. Speak slowly and clearly and offer orienting statements as needed.
- Irritability, aggression, and immature behavior.
- Regressive behavior -- young children may communicate as if a younger age (e.g., “baby-talking”) or have difficulty acting independently to the extent they were able prior to the crisis event.
- Stress related physical symptoms such as headaches or stomachaches. For individuals with a predisposition, stress can also precipitate or exacerbate symptoms of underlying medical conditions such as asthma.
- If the death of a family member or friend is a result of the crisis event, children may also demonstrate signs of active grief.
- Children may also demonstrate withdrawal and become silent.

Even when under tremendous distress, children may not show any signs or be reluctant to share their concerns with others, especially adults they do not know or trust. Health care providers therefore need to work quickly to establish a trusting relationship with the child and family members (e.g., by explaining in clear and simple terms who you are, what you plan to do, why you are taking certain actions and how those actions are intended to help and protect them, and by asking them to share with you their concerns, worries, and questions).
Conduct a brief triage to identify children most likely to benefit from additional mental health service.

Prehospital providers can play an important role by validating children’s (and other family members’) feelings and reactions and by encouraging them to express their concerns and seek and accept assistance and support. There is a great deal of stigma associated with mental illness and it does not go away in the aftermath of a major disaster or crisis, even when many, if not most, individuals are having adjustment difficulties.

An initial triage should be conducted to identify those children most likely to have difficulty with adjustment so that they can receive early referral to supportive services. A history of selected risk factors, many of which relate to the degree or extent of personal involvement or exposure, should be obtained including:

- If the children are direct victims, especially if they suffer serious physical injury, or if close relatives or friends died or were seriously injured.
- If they directly witnessed death, serious injury or other horrific images, especially if the victim is a family member or friend or someone known personally.
- If the children perceived at the time of the event that their life, or that of a family member or friend, was in jeopardy (since young children’s perceptions of risk may deviate greatly from actual risk, it is important to learn what children believed to be the level of risk).
- If the event results in separation from parents/caregivers or loss of property, pets, or personal belongings.
- If the children had pre-existing mental health problems.
- If the children have a history of prior unaccommodated losses (e.g., death of a family member) or traumas.

In addition, certain behaviors seen in the immediate aftermath of the event also represent risk factors for longer-term adjustment problems, including:

- Intense fear or anxiety, panic, helplessness, or horror
- Uncontrollable and intense grief
- Dissociative symptoms (such as detachment, derealization, and depersonalization)
- Extreme cognitive impairment, very intrusive thoughts, confusion, or poor concentration and decision-making skills
- Marked physical complaints that are inconsistent with physical examination or history

The health care team should also assess the current coping of the parents/caregivers. Parents who are having difficulty coping themselves or who lack the skills to facilitate communication or to provide support to their children are more likely to have children who would benefit from additional mental health or supportive services in the aftermath of disaster or crisis.
Prehospital providers often play an important role in identifying and addressing mental health concerns.

Prehospital providers generally appreciate the critical role they can play in ensuring the ultimate health of children through timely and accurate identification of emergent health concerns, early intervention, and effective and rapid triage. Such is the case as well for mental health concerns, especially in the aftermath of a disaster or other crisis event.

In addition, the prehospital provider will often be the first point of contact for the health care system after a crisis event. Even though it is not possible nor appropriate to conduct a lengthy evaluation or to begin long-term treatment for mental health concerns, conducting effective triage for emergent mental health needs and establishing a supportive, but not intrusive, relationship that encourages further assessment and treatment by others within the health care system is a critical first step in addressing mental health needs.

Prehospital providers should also be cognizant that they may have direct access to important information about the nature of the event or children’s personal involvement in the event from their discussions at the scene that will be lost if not recorded or transmitted to other professionals. As they strive to make sense of the crisis event in the future, children and their families will be helped if they are able to reconstruct the story of the events of that day – what happened, where they were at the time and what they were doing, how and why they were effected by the event, how they were helped, etc. By recording a brief narrative of the events as known or described by victims or others at the scene at the time or other relevant information (e.g., “the child was found unconscious underneath a portion of the staircase that appears to have fallen and hit the child in the back of the head – suggesting that the child was injured while attempting to exit the house”), information can later become known to the family that may assist them in the recovery process. In some situations, it may be possible for the prehospital provider to offer professional contact information so that interested family members can later reconnect to obtain directly such information (that may not be possible or appropriate to communicate at the time of the crisis).

Prehospital providers may also wish to assist in community responses to a disaster or other crisis event that will help children adjust over time. For example, they may offer training to school-based staff in first aid and emergency response or volunteer to become an active member of a school crisis response team.2

**Selected References:**


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10: Psychological First Aid

Suggested Websites:

www.aap.org/disasters (American Academy of Pediatrics)
www.cincinnatichildrens.org/school-crisis (National Center for School Crisis and Bereavement)
Chapter 11: Pediatric Patient Identification and Tracking: A Practical Approach to Implementation

Connie Maxim EMTP

Background: The Issue of Fractured Families, Hurricanes Katrina and Rita Reviewed

In the wake of Hurricanes Katrina and Rita, lessons learned indicate the need for accurate accountability of patients, victims, and evacuees. The pediatric population specifically requires special considerations when involved in a disaster of any kind. America watched as stories unfolded in newspapers and television broadcasts across the country of children stranded, lost, and unaccounted for. Pediatric patients require unique and specialized considerations when identifying and tracking disasters victims, all pediatric disaster victims should be tracked electronically by both responders and receivers throughout the disaster response process.

According to National Center for Missing & Exploited Children (NCMEC), it is estimated that about 411,000 people dispersed to 48 U.S. states in the aftermath of Katrina and Rita. Of those 411,000 people, an estimated 5,000 were children listed as separated or missing from their families. A total of 5,182 cases of missing children were reported to the NCMEC. Some 5,050 of those cases were considered resolved, a 98 percent success rate. Most of the children were considered to be lost, rather than missing. Given space limits on buses, in shelters, and at hospitals, children were often given first priority in evacuation. These “fractured families” often were comprised of parents in one state, with children in another state. Many children reported missing, eventually were found to be with other relatives or friends, unbeknownst to the parents. This separation occurred during rescue efforts, sheltering efforts, and facility evacuation processes.

The pressure to identify and mitigate each component of a disaster is overwhelming. You do the best you can with what you have. As families try to reach safety, responders become overwhelmed by the shear number of victims involved. A victim may not necessarily become a patient. Limited resources become an even more troubling problem to overcome.

As evacuees of Hurricanes Katrina and Rita knew, children took priority, parents were willing to send their children to safety and wait for the next bus, but what if the next bus didn’t come? What if the next bus went to another shelter, in a different state? This was common in the response to Katrina. The flooding presented a need for everyone to shelter in alternative locations, most out of state.

Children given priority were separated from their parents and relatives, even separated from other siblings. In many instances, older siblings would take younger siblings with the unbelievable responsibility of making sure that everyone arrived at a shelter safely. Parents shared stories of children being passed forward through a crowd of people in the hopes that
their children would make it on a bus out of New Orleans. Some children were sent with elderly relatives who took precedence over adults as well, the older child becomes responsible for both the youngest and eldest of the family, and parents were left to scrounge for the next ride out.

States across the southern portion of the United States were charged with housing all of the evacuees in Katrina’s aftermath. Shelters emerged everywhere, run by the Red Cross, some by non-profit organizations, others by faith based organizations, all without a way to communicate with one another. Disconnect at rescue and transportation created a flood of evacuees arriving at shelters separated from one another, most having very little information about where their relatives may have gone. Shelter workers learned quickly that most children were unsupervised and/or unaccounted for. Children in shelters became products of foster care systems until parents or relatives could be found.

Throughout the process of facility evacuation in New Orleans, immediate transfer became a challenge. Finding beds for sick children was difficult, coordinating a receiving site for the parents and the children, daunting. Pediatric patients were loaded onto helicopters from the roofs of hospitals, while parents at home or with relatives, were taken by boat to a bus station for transfer to the Houston Astrodome, or shelters similar to this. Neither evacuation operation was aware of the family connection, all concentrating on transport out of the effected area, desperate to find safety. Parents may or may not have been at the hospital at the time of evacuation, and may very well be evacuees themselves.

Sending, transferring, and receiving facilities, providers, and volunteers would have benefited from a centralized, real-time tracking system. The entire disaster process needed victim accountability. A centralized database of identity specific demographic information, combined with associated start and end points in the stages of evacuation, shelter, and facility transfer would have eased the reunification process.

**Identification and Tracking of Separated and Displaced Children**

**Time Imperative**

Time is of the essence when considering separated and displaced pediatric population in a disaster. Real time technology, like web-based patient tracking systems, provides an ability to track basic information as it occurs. A baseline of pertinent demographics allows for general identification and flow of patients in the disaster response process. Lessons learned by the NCMEC pointed directly to the critical importance of time when children become separated from parents or loved ones. Having existing technology and infrastructure associated with patient tracking will eliminate factors associated with playing catch-up at the time of the event.

**Photography as a Tool for Identification and Reunification**

Photo technology is a major component associated with pediatric patient identification. In the Katrina and Rita response, NCMEC used photo technology for reunification of pediatric
patients. At the time of evacuation, personal preparedness is essential. Among the cache of important documents suggested for evacuation of pediatric victims include a recent photograph of children as well as other family members and close friends. Children can easily identify close relatives and family friends or daycare providers by photograph. Children may not know last names or first names, depending on their age, but a photograph is universal. A child can very easily say, “That’s my Nana.”

Tracking systems are capable of attaching a simple .jpeg or .gif photo taken by digital cameras. Immediate access to photographic information is crucial to development of reunification flyers and posters in the minutes, hours, days, weeks, or months after the onset of a disaster situation. Photographs are easily disseminated through multiple media and technology channels. Data captured immediately during the disaster response process, combined with digital photography are essential to limitation of separated and displaced children involved in a disaster.

**Data Collection**

Information is crucial at the time of a disaster, the question becomes what information is necessary vs. optional. This can be a topic of debate amongst different disciplines vested in pediatric disaster response. Emergency Medical Services (EMS) may need information pertinent to movement of a patient from one place to another. Public Health may be interested in the epidemiological components associated with the pediatric disaster victims. Emergency Management may be more interested in the general number of pediatric patients taken to a shelter, and the resources necessary to support them. The solution relates back to identification of an individual, the location from which they started, and their end destination.

Data associated with identification include a unique number, age range, gender, ethnicity, and agency with initial contact. Patient tracking systems can be multi-functional for both identification and information sharing amongst various agencies within the disaster response process. Some multi-functional data components include triage category, general chief complaint, and the priority of the victim if necessary. This type of information is helpful to both first responders managing mass casualties on scene, as well as first receivers or shelter organizers anticipating the influx of victims or patients. The unique identifying number can be associated with a triage tag or created within a tracking system. It is essential that every entry into a tracking system be date and time stamped with each scanned update.

When considering data pertinent to disaster response, various groups want different but vital pieces of data. It is difficult to speculate which components of patient information are helpful to whom. The best suggested strategy is to bring all players vested in tracking information to the same table. Public Health, Healthcare, EMS, American Red Cross, Emergency Management, and many others all have a piece of the tracking puzzle. This group of vested partners can discuss common data points of interest, while addressing areas not thought to be helpful to other disciplines. Listing each piece of data helpful to all partners provides a list of common crossover. The group can then identify the overlapping data sets, and define the primary areas of patient information needed.
One example of the kind of working partnership is the Region 6 Bioterrorism Defense Network Coalition of Michigan. Tasked with setting up a patient tracking system, partners identified what they felt would be helpful and vital information. A group of hospital, Medical Control Authority (MCA), Public Health, Emergency Management, and State Administration sat down and developed a list of data. The group identified priority information to be captured on scene, as well as helpful information that could be entered into the system at a hospital or shelter after transport. A patient tracking system should be flexible enough to depict which pieces of information are gathered during specific phases of disaster response.

Primary on-scene data identified by the Region 6 Coalition were: date, time, unique identifying number (disaster specific), gender, age range, START triage category, general chief complaint, destination, transporting agency, priority (if applicable), and ethnicity. Upon arrival or transfer necessary data included: date, time, unique identifying number, agency unit number, medical record number (if transported to a hospital), date of birth, first name, last name, and destination county. Any agency using the tracking system would have the ability to enter in as much of the data as possible, but at the very least, on scene data provides a narrow margin of patients to search. Destination information provides specific patient information and cross reference information that may be necessary when trying to reunify children with parents.

**Approaches to Identification and Tracking**

**Identification of Tracking Systems**

There are many different patient tracking systems on the market today. Some tracking systems are locally installed on individual desktop computers connected through a shared server. Some systems use stand alone units deployed at the time of disaster to specific roles within the Incident Command structure i.e. triage officer, or transport officer. There is widespread debate over tracking on a daily basis as opposed to just in times of disaster.

Tracking systems may or may not be compatible with each other, or capable of sharing common data sets. This is a very important consideration when evaluating system needs. When considering mutual aid response, the optimal goal is information sharing and interoperability. Carefully investigating the type of platform the system operates within is crucial. Some tracking systems are compatible with Microsoft Office programs like Access or Excel, other tracking systems operating on proprietary platforms, this may limit it's capability for sharing data across multiple jurisdictions. Ideally, a tracking system should be flexible in its structure to accommodate the specific needs of an agency or agencies. Any tracking system being considered should be configured for both day-to-day use and mass casualty response.

Some systems have preset data sets and associated information; this can limit a group's ability to capture desired and necessary information. There are some systems that do not preset the data fields, and can be tailored to the needs of that specific group, these are ideal for multiple jurisdictions interested in gathering a variety of information pertinent to
Patient Identification & Tracking

Identification and tracking. Hardware and software configurations are very important; both groups have unique considerations that need to be discussed prior to implementation. Health Insurance Portability and Accountability Act (HIPPA) issues need to be taken into consideration, patient information must be shared as securely as possible.

Hardware and Associated Infrastructure

When considering hardware configurations, assessing existing hardware will be very helpful. With the development of electronic documentation, EMS agencies may already have some hardware needed for a patient tracking system. There are a variety of hardware setups, and they range for laptop computers, handheld 2-D and 3-D barcode scanners, cellular phones with scanning capabilities, pocket personal computers capable of scanning, modem and wireless card connections, and a central server. There are rugged hardware components that can withstand the elements of scene response.

PDA handhelds are being used for other medical records needs within facilities like Monash Medical Centre in Victoria, Australia. Monash Medical Centre uses the rugged PDA for bedside registration. These handhelds are capable of wireless communication and barcode scanning. The wireless functionality creates a real time tracking environment for registration of patients. Monash Medical Centre is an example of existing information technology infrastructure, wireless hot spots, having another functional role within the patient care environment. The bedside patient information process used at Monash Medical Centre can be paralleled against EMS responding to a scene. The ability to enter pertinent patient information on scene provides immediate, real time information for accountability.

Software Considerations

Software has unique challenges. Interoperability is essential to any tracking system that may be used in a mutual aid environment. The software platform is very important. Any system that functions within a Microsoft Access or Sequel Server environment can be tailored for sharing and interoperability. Consulting with information technology professionals involved in EMS, MCA, and hospital systems is very helpful. Software may compromise firewall structures, HIPPA considerations need to be identified. Pre-planning with information technology professionals is crucial for successful software deployment.

When investigating software packages available, there are a variety of licensing arrangements that can be purchased. As these licensing arrangements are discussed, it is important to consider the funding used to pay for such systems, and whether or not partners are willing to pay licensing fees each year. Some licensing fees can be astronomical, and may need to be paid yearly. Tracking systems purchased under an enterprise license allow for ownership of the program and user licenses without maintaining a considerable licensing fee each year. Depending on the size of the healthcare system, enterprise licensing may be the best option to ensure continuation of the tracking system independent of funding. Technical support may also be included in any contract for purchase of tracking software. Included in the technical support should be allowances for software upgrade and twenty four hour access.
to technicians. At the very minimum, yearly costs may be associated with wireless access abilities in the field and costs associated with central server hosting and maintenance.

Patient tracking systems should be capable of both entering data, as well as searching for data. It is not necessary for every user to have the ability to enter data, but may be helpful to allow access to multiple users for searching data within the system. Some tracking systems allow for data entry and query, others will provide a limitation component that would only allow users the ability to search with protected username and password. One system identifies users across any jurisdiction with password access to simply search unique information, or combinations of information immediately to locate patients involved in a disaster response. It is very similar to systems currently being used by shipping companies, as a customer shipping a package, they are able to access a website, enter in specific tracking information provided to them, and track the progress of the package being delivered. Real time, web-based searching capabilities would have been incredibly beneficial in the responses to hurricanes Katrina and Rita. With a web-based searching component of the tracking software, most entities can use existing infrastructure, lessening the burden to purchase additional software and hardware that may not be budgeted.

Johns Hopkins Hospital in Baltimore, Maryland utilizes this type of software configuration to track and locate medical supplies flowing throughout the system, over 1,000 packages a day. Prior to implementing the UPS TrackPad system, anytime an employee needed to locate necessary medical supplies, the receiving departments were required to sort through various files and papers to locate a piece of equipment or medical supply. With systems like the TrackPad system, Johns Hopkins Hospital scans every package upon arrival and automatically assigns a unique tracking number. This information is downloaded to central server for all users to search. The hospital server is already being used to share and streamline patient records, the tracking system was just a software installation that provided staff immediate access to searching capabilities for supplies necessary for patient care. According to administrators at Johns Hopkins Hospital, the system implemented has "significantly reduced problems with misplaced packages." This can be translated to misplaced patients; it is a matter of shipping and receiving. Identification and tracking systems exist, and can be implemented seamlessly, if the right considerations are discussed.

**Other Methods to Track Pediatric Patients**

**Red Cross Safe and Well Website**

The American Red Cross hosts a website called safe and well. The purpose is to allow individuals who have been separated from their family to post information about their well-being and location. The information regarding an individuals name & location and pre-formatted message can be accessed by friends or family by searching the web site using the individual’s phone number and / or home address.

Only people who search for a particular phone number or address will be able to access that individual’s name, preformatted message which includes: wellness status, location, and how
they will contact family. The exact location or best specific phone contact can not be left on the website. Only pre formatted messages including: I am safe and well; Family and I are safe and well; Currently at Shelter, home, neighbors, hotel; Will call, email, send postcard when I am able; can be left and accessed. Exact information regarding person’s location, and contact info are not accessible due to privacy concerns.

Although useful for older children and adults who are able to provide their home phone or home address to log their message, this contact method of looking for younger children, or developmentally delayed individuals etc. will not work if a pre disaster phone and address are not available. Young children cannot provide this information so an adult assisting them will not be able to log information on to this website. Also exact location and contact information cannot be transmitted. This makes it difficult for those searching for the displaced person to exactly identify the person’s location or how to get in contact with them.

The Safe and Well website can be accessed at: https://disastersafe.redcross.org/Default.aspx.

Accompanied Child in a Disaster

Children and the accompanying responsible adult should be able to be tracked and linked to each by having a matching adult and child tracking number or code. One possible solution to tracking these pairs is to use a system of identification bands. These paired ID bands should be distributed as soon as the responsible adult and child make contact with official caregivers in the disaster area. The ID bands or other devices should be placed rapidly and accurately on both adult and child. Completing this paired identification will help to ensure that the paired identification is completed before the adult and child can be separated, and also reduces the possibility of human error during the matching and placing of the bands. Similar policies are used to track mothers and their newborn babies on newborn and maternity wards.

The paired identification bands used should include the following information, which will be useful in maintaining a tight link between child and adult:

- Name of child
- Child's date of birth
- Name of adult
- Adult's date of birth

A more sophisticated approach to tracking could be implemented by the use of paired bar coded bracelets. These would be available in pairs or sets. The identical bar code ID would be affixed to the child and responsible adult. The bar code would have a unique series of letters and numbers that would be the same on the child and adult’s ID device.

Displaced or Unaccompanied Child in a Disaster

Rapid identification and protection of displaced children (less than 18 years) is a critical part of disaster management, as rapid identification and reunification will reduce the possibility
for maltreatment, neglect, exploitation, and emotional injury. The separation of children from parents also increases the rate of traumatic stress responses in children after a disaster.

All hospitals, medical clinics, and shelters providing care to child survivors of disasters should immediately implement appropriate child-safety measures in direct response to this crisis. The CDC has reviewed and approved a protocol to rapidly identify and place unaccompanied children in a safe area after a disaster. The CDC found this useful resource important enough to share with its partners to promote a safer and healthier environment for displaced children in shelters.7

**Protocol to Rapidly Identify and Protect Displaced Children**

Survey all children in your hospital, medical clinic or shelter to identify children who are not accompanied by an adult; these children have a high probability of being listed as missing by family members. Find out where they are sleeping/ being held and the name and age of person(s) who is/are supervising them, if available.

Place a hospital-style identification bracelet (or, ideally, a picture identification card) on the child and a matching one on the supervising adult(s), if such an adult is available. Check frequently to make sure that the wristband matches that of the adult(s) seen with the child in the hospital or shelter. If there is no supervising adult, the child should be taken to the hospital’s pre-determined pediatric safe play area where he/she can be appropriately cared for until a safe disposition or reunification can be made.

The names of all children identified through the survey as not being with their legal guardians or who are unaccompanied should be considered at high-risk and immediately reported to the hospital’s emergency operations center. Additional reporting should also be made to the National Center for Missing and Exploited Children (NCMEC) at 1-888-544-5475. The NCMEC can then crosscheck them with the names of children who have been reported missing.

After the “high risk” children have been reported, a complete list of all children names in the hospital, clinic or shelter should be sent to the office of emergency management or other agency responsible for tracking (if activated and the information is requested.)

Unaccompanied children and those who are not with their legal guardians should undergo a social and health screening taking into consideration an assessment of the relationship between the child and accompanying adult, ideally performed by a physician with pediatric experience. This protocol is most useful for accompanied children, or unaccompanied older children who can provide their name and date of birth.

The most difficult tracking and identification problem includes children already separated from their responsible adults / families, are too young to provide their family name, or any name at all. These children may be tracked by providing an identification device (tag or band), which includes a unique tracking number. Information on this tag, linked to this number should include child-identifying information (eg. approx age, gender, hair, eye, skin color, other identifying marks; a picture of the child would also be useful but this requires
technology to produce instant printed photographs that are laminated / protected). Other information should include agencies involved in initial identification, and the start, intermediate and end points in the child’s journey from the disaster site to a hospital, or shelter.

**Tracking without Bar Codes, Pictures or Pre prepared Tags**

In some circumstances tracking of children must be initiated without the benefit of pre made matching bar code tags, IDs, or photographs. If a child and adult are going to be separated, an indelible marker can be used to write the following information on both the child and adult’s skin: The child’s name and date of birth, adult’s name and date of birth. This method provides a rapid, low tech method to match the child and adult that can last for weeks to months.

**Summary**

Pediatric patients may present challenges for all involved in the disaster response process. Reunification is a very important piece of the disaster puzzle. Utilizing real time patient tracking systems may significantly reduce the number of children separated or displaced from relatives. Patient tracking systems are ideal for both day-to-day and disaster response scenarios. Responders and receivers should be very familiar with tracking systems in place for accurate accountability of all victims impacted by a disaster.
Region 6 BioDefense Network Coalition Tracking System

Barcode Triage Tag – Each barcode on the front side of the tag is a sticker
System Set-Up

Once data is entered by one or more EMS units, it is sent to / stored in a SQL Server visible to partners with software.

Orange: Data Transmission via wireless infrastructure
Blue: EMS vehicle(s) enroute to destination(s).
Tracking System Components

The Region 6 tracking system provides responders and receivers the ability to enter in vital information at beside or on scene. The patient can be given a generated number by the system, or use a barcode tag provided by the Region to partners.

First responders are able to input additional identifying information upon arrival at either a hospital or shelter.

Users are able to search the tracking system by eight different categories, as well as date, date range, time, or location. The agency or unit searching is able to identify themselves and search accordingly as well.

Each patient is tracked by a unique identifying number, when any user enters the patient into the system, a time and date stamp is added to the record. The record becomes a time threaded account of the patient’s movement through the disaster response process. This is an example of the report created, the patient data shown is hypothetical. All data in the threaded record is searchable, providing a very quick and accurate system that all first responders and receivers can use on both a daily basis, as well as in the time of disaster.
The Region 6 tracking system has four hardware components needed to achieve real time web based patient tracking: handheld barcode scanners with wireless capabilities or a laptop, a wireless modem or card, central server for hosting all data from across the west side of the State of Michigan, and desktop computers at each destination.

Software is installed on handheld PDA’s and local desktop and laptop systems. The software is configured to connect and update automatically each time the program is launched in any of the hardware devices. All patient information is downloaded by either tapping a send button on the handheld, or immediately following key entry into the laptop or desktop units. Searching is both within the software itself, or by a web based application that is username and password protected. This provides the ability for many users to search without the ability to enter data.

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Chapter 12: Natural, Technological & Intentional Disasters

Baruch Fertel MPA EMT-CIC

Overview

In EMS terms, multiple-casualty incidents (MCIs) and mass-casualty events (MCEs) are defined in terms of their impact on local resources. An MCI is an incident that has multiple patients that can be handled by one agency or jurisdiction, while an MCE, also called a disaster or a catastrophe, is an event that overwhelms the local EMS system’s resources so that additional EMS agencies must be mobilized to assist. Because of this definition, an event could be considered a disaster or a catastrophe in a community with limited resources, while in another community with extensive resources and adequate mutual aid coverage it would have a negligible effect. Furthermore, an event that would normally be handled as an MCI could be upgraded to an MCE because of unusual circumstances—a nurses’ strike at the receiving hospital, for example, or a multi-vehicle collision that occurs when the local trauma department is unusually busy.

This resource uses the term “disaster” since that is the term in most common use. The word “disaster” is derived from the Latin words for “evil star”. Merriam Webster’s dictionary defines a disaster as “a sudden calamitous event bringing great damage, loss or destruction”. EMS providers and agencies must be prepared to respond and treat children in all types of disasters.

The widespread injury and disruption associated with disasters can pose difficult problems for EMS providers as outlined in the various chapters of this resource. Furthermore, the degree of injury, death, and damage caused by disasters is influenced by many factors, including population location and density, timing of the event, and community preparedness (e.g., emergency response infrastructure, local building codes, etc). Similarly, recovery after a disaster is influenced by resources (e.g., relief aid), preexisting conditions (e.g., season, local infrastructure, etc), experience, and access to information.

Most disasters do not result in unusual pediatric injuries or illnesses—just more of the same types of problems EMS personnel are used to treating. Attacks involving bomb blasts or chemical, biologic, or radiologic weapons, however, are likely to cause unusual presentations throughout the affected population. Because children’s anatomy and physiology may make them more susceptible to such weapons, EMS providers will probably encounter large numbers of ill or injured children after an attack. Factors unique to terrorist acts and warfare are discussed below.

Types of Disasters

Disasters fall into three categories according to cause: natural disasters, technological disasters, and intentional, or human-made disasters. Natural disasters are caused by weather or geologic phenomena, such as hurricanes, droughts, earthquakes and avalanches. Technological disasters arise when human safeguards fail, resulting in plane crashes, toxic spills, industrial explosions, and similar events. Intentional disasters, which often involve technology, are deliberately triggered by one or more individuals (often referred to as terrorists), using such means as industrial sabotage, toxic release of CBRNE (chemical,
biological, radiological, nuclear, explosive & incendiary) or WMD (weapons of mass destruction), hijackings, bombings, and sniper attacks. There is often overlap between these areas. For example, an earthquake (natural disaster) can cause explosions and toxic spills (technological disaster). Consequently, these injuries, while only discussed in one section of this chapter, still apply to other scenarios. EMS providers must be flexible and prepared to respond and treat injured children in any of these circumstances. It is also important for EMS agencies to train for these disasters, as studies have shown that emergency response training, safety drills and simulations, and medical training in appropriate responses to hazardous agents can greatly limit subsequent injury and death when accidents occur.  

**Natural Disasters**

Natural disasters are caused by severe weather or geologic phenomena, such as hurricanes, tornadoes, floods, tsunamis, droughts, wildfires, earthquakes, landslides, and avalanches. Some of these events, such as earthquakes and tornadoes, can occur suddenly, with very little warning. An EMS agency in a community at high risk for such incidents must therefore maintain a constant state of readiness. Other natural disasters, such as hurricanes and floods, are more predictable and may have a gradual onset, allowing agencies time to implement disaster plans.  

**Floods** are the most common of all natural disaster, accounting for roughly 30% of disasters worldwide. Recently the news has been dominated with the devastating effects of flooding seen in Iowa during June of 2008. In fact, the damage of many other forms of natural disasters is often exacerbated by flooding.  

Flash floods are especially hazardous. They occur during sudden heavy rains, tidal surges, or when dams or levees give way. Most of the deaths during flash floods are caused by drowning, usually from people wading or driving through moving water. Children are more vulnerable to near drowning and drowning, and are at risk with smaller volumes of water than adults. EMS providers must be prepared to recognize the signs of near-drowning and be prepared to treat accordingly.  

The hazards posed by rapidly moving water are often unrecognized. A gallon of water weighs 8 pounds; hundreds of gallons of rushing water represent thousands of pounds of force. Rushing water only two feet deep can carry a vehicle away. Children are certainly children no less susceptible.  

Fortunately, with the exception of flash flooding, floods are generally not directly associated with significant loss of life. However, flooding results in considerable destruction and disruption, and has the potential for widespread disease. Floodwaters frequently contain human or animal waste from sewage or agricultural systems that can lead to epidemics of infectious disease. Drinking water must be disinfected through boiling and/or chlorination, or an alternative clean water supply (e.g., bottled water) must be identified and made accessible. An EMS agency should consider maintaining a stockpile of water for the use of rescuers during these events. Water supplies and household surfaces can also become contaminated with petroleum products (e.g., fuel oil or kerosene), household chemicals, and molds. These diseases can have a profound affect on children. Many of these diseases can cause vomiting and diarrhea, symptoms that can be quite severe in children, who have reduced surface to volume area, and are very sensitive to losses of bodily fluids electrolytes.
The EMS provider must constantly monitor vital signs, be vigilant for signs of hypovolemia (shock) or electrolyte disturbances and be prepared to provide appropriate supportive care.  

EMS providers are taught that scene safety is of paramount importance lest rescuers become patients themselves. Since contamination of floodwaters also poses a hazard to EMS providers, rubber boots and gloves should be worn, and open wounds and sores protected. Hands should be washed frequently, especially when handling food or food containers. Foods that may have been contaminated should be discarded and eating utensils should be thoroughly washed and disinfected. Materials that cannot be readily disinfected should be discarded.

The aftermath of a disaster (especially natural) is also the source of considerable injury and destruction. Hence, the medical management provided in the aftermath of a disaster is critically important. The disruption caused by disasters can result in widespread disease from unhygienic conditions. Fuel leaks, live wires, and other hazards can cause injury or start fires. The physical and emotional stress associated with the event and cleanup can result in heart attacks, musculoskeletal injuries, mental illness, and other stress-related disorders. Displaced wildlife can hamper relief efforts and endanger workers. Injuries can also result from improper use of chain saws or other mechanical equipment involved in clean-up efforts. Children are especially prone to injury or poisoning through access to debris, chemicals, equipment, and other agents discovered while exploring in the aftermath of the disaster.

When returning to a building or structure after a disaster, occupants need to check for structural damage, gas leaks, downed power lines, or other potentially hazardous situations. Sites should be inspected during daylight so that hazards are visible, and only battery-powered flashlights or lanterns should be used for auxiliary light, rather than candles, gas lanterns, or other open-flame devices, to minimize the possibility of secondary explosions.

Immediately after a disaster, governments and community organizations will be called upon to provide safe (e.g., bottled) drinking water, as well as shelter, food, clothing, and medical care for displaced people. Victims will also look to these organizations for other services, including counseling and assistance with insurance claims and other sources of emergency funds.

**Earthquakes** are a potential hazard throughout the continental United States, especially in the regions of California, Idaho, Utah, and the Pacific Northwest. Of note is that only part of the destruction caused by earthquakes and their aftershocks occurs during the event. Subsequent events triggered by the quake, such as fires, tidal waves, and so on, can cause significant destruction.

**Hurricanes and tornados** are similar weather events that differ in magnitude and location. Both involve rotating masses of air associated with severe weather. Tornados usually affect a small geographic area, while a hurricane can affect a rather large area. Both can have winds of up to 200 mph, but hurricanes are associated with much more energy and have much more potential for destruction. Tornados develop primarily over landmasses, especially those within the Midwestern and Southwestern United States, while hurricanes are associated with the coastal United States, primarily the East and Gulf coasts.

Although hurricanes are associated with high winds, much of the destruction they cause is from the so-called “storm surge” and subsequent flooding. This can result in all the problems...
noted above for flooding, including the risk of drowning, electrocution, and disease associated with contaminated drinking water.

**Tsunamis** are tidal waves resulting from underwater earthquakes. They can cross thousands of miles of ocean at speeds up to 500 mph. When these gigantic waves break, they can destroy piers, buildings, and human life far inland from the severe flooding.

**Wildfires** (brush or forest fires) can disrupt communities and cause substantial property damage, displacement, serious burns, and death. In addition, smoke from wildfires can result in irritation and respiratory difficulties, especially among those with preexisting medical conditions or impairment. EMS providers must be prepared to treat children with respiratory distress and potential airway burns, as well as surface burns and heat exhaustion.

**Technological and Intentional Disasters**

There is considerable overlap between technologic and intentional disasters. Technological disasters arise when human safeguards fail, while intentional disasters utilize malicious means to circumvent these safeguards. The key difference between these two types is that inherent in the intentional disaster is the desire to instill fear and cause chaos, thereby magnifying the destruction.

**Accidental technological disasters**

We live in an era of advanced technological capabilities. These technologies may pose a hazard to humans. With increased sighting of technological facilities in residential areas, the potential for exposure to children is great. Possible scenarios involve the unintended release of industrial toxins, radioactive materials, or other hazardous materials during their manufacture, storage, transportation, or use. This was illustrated in the Bhopal chemical release and the Three-Mile Island nuclear accident. Other forms of large disasters include plane crashes, train derailments, and other failures involving mass transit systems as well as structural failure of buildings, bridges, mine shafts, and other constructs. Here too there is considerable overlap in the types of disasters encountered. For example, a train carrying chemicals that derails brings about both physical damage, and the release of toxic substances.\(^1\)\(^2\)

**Intentional disasters**

Intentional disasters, which also often involve technology, are deliberately triggered by a person or group. The reasons for committing such acts vary widely, and may result from political, social, religious, or emotional motivation. Intentional disasters are the least predictable of all disasters, and can take place on the spur of the moment as in school or workplace shootings, or they may involve detailed advance planning as in the 9–11 terrorist attacks on the World Trade Center and the Pentagon. Terrorists do not spare children, and in fact may specifically target children as victims. Their main consideration is the impact of their act on furthering their cause.\(^1\) Children have been and will be victims of terrorist acts. Schools, gyms, sporting events, concerts, amusement parks, shopping malls, or any other place where there are mass gatherings are all potential terrorist targets. The hostage taking in a school at Beslan in Russia and the selective bombing of the day care center in Oklahoma City vividly illustrate the threat to children.\(^2\)
The nature of these disasters can vary from simple arson or sabotage, to release of chemical or biological agents, or even to detonation of a primitive nuclear device. These disasters are also associated with most of the hazards described for accidental, and sometimes even natural, disasters. However, the malicious nature of the event and the fear associated with biological, chemical, and nuclear agents result in even greater stress and social disruption. Release of a product such as an agent of opportunity, i.e., items normally found in hospitals or other technological environments that can be turned into destructive weapons, into the ventilation system of a local school or other such sites could result in rapid spread of an agent throughout a community.

To compound the damage they cause and inflict further fear and chaos, planned attacks may include a delayed or “secondary” event that is timed to correspond with the arrival of rescue personnel. This can be in the form of an additional accomplice or another device. It is important that EMS providers be prepared for this possibility. Extreme caution should be used when entering a disaster scene, and confirmation of scene safety should be verified by public safety personnel prior to the entry of EMS personnel. Once cleared, scene time should be reduced to a minimum to avoid further exposure. Disasters involving children are especially stressful for the EMS provider. Although there is a strong emotional desire to “jump in” and begin rescuing, scene safety is of paramount importance and must be verified, lest the injuries become magnified.

**Compounding factors**

The period immediately following a disaster (especially natural) is a risky time for children. As a result of the damage inflicted, electric transmission lines or capabilities may be down, leading to motor vehicle collisions at intersections where traffic lights are out, the absence of air conditioning in warm weather, or the inability to provide water purification. Burns or inhalation injuries may arise as survivors use open flames for light or heat. Children may also wander in areas of unstable buildings or other structures, or be caught in the middle of looting or lawless behavior during periods of civil disruption. The presence of displaced pets or wild animals roaming the streets seeking food or shelter can also lead to bites and other injuries when children encounter them.

Environmental factors can also exacerbate or create existing or additional injuries. Hot weather increases the risk for hyperthermia, dehydration, severe sunburn, and complications of insect bites, while cold weather increases the risk for hypothermia as well as carbon monoxide poisoning from improperly ventilated combustion heaters or generators.

**References**


Chapter 13: Physical Disasters

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Epidemiology

Most authorities predict that a terrorist attack with chemical agents would utilize an aerosol route of exposure. Radiologic attacks might include explosions at a nuclear reactor, a “dirty bomb” utilizing conventional explosives to disperse radioactive material, or conceivably detonation of a nuclear weapon. Chemical or radiological attacks would likely combine elements of the traditional mass casualty event (MCE) and a hazardous materials (HAZMAT) incident. Most victims affected would be afflicted in one place, almost simultaneously, and recognized early on, and many would receive field care and decontamination by EMS personnel. Still, many parents, exposed or not, will transport themselves, with their children, to nearby hospitals without prior care, so that hospitals will need to be vigilant and prepared to provide some decontamination and triage capacity, as well as definitive care. Every EMS agency should be prepared for such an incident, through familiarity with these agents, the stocking of appropriate antidotes, a quickly deployable decontamination unit, and personal protective equipment (PPE) for those staff who will be expected to assist with extrication or will provide emergent resuscitative care prior to or coincident with decontamination.

In contrast, a biological event would likely result in patients presenting in various locales over time, similarly to a natural infectious disease outbreak. The epidemiology of such an event is further outlined in a following section. Of note, such an intentional epidemic would likely be more compressed in time due to the synchronous exposure, perhaps involving more “exotic” diseases than usually encountered in a given geographic area, while the patients themselves might exhibit a particularly high degree of morbidity and mortality. Some of the diseases caused by agents of bioterrorism are highly contagious, and special isolation precautions will be necessary for the safety of EMS personnel.

Specific Vulnerabilities in Children

Important physiologic, developmental, and psychological considerations unique to children may increase their vulnerability to a WMD attack. Children have relatively greater ventilation for body size than do adults (minute ventilation), and “live closer to the ground”, potentially increasing their exposure to airborne toxins, infectious particles, or radioactive fallout, which are usually heavier than air. Infants and toddlers are limited in their ability to escape danger, particularly if adult caretakers are critically injured or dead. The witnessed loss of parents and siblings might lead to extraordinary post-traumatic stress reactions. In addition, EMS systems may be less capable of handling a large surge in pediatric patients than might be the case for adults, given the considerably less frequent EMS experience with critical pediatric patients, and less capacity for rapid expansion of pediatric hospital beds. EMS staff garbed in bulky PPE might be particularly handicapped when challenged by the need for emergency procedures on infants and small children.

Chemical Agents

The major chemical weapons of concern are the nerve agents, such as sarin, used by Japanese terrorists in the infamous Tokyo subway attack in 1995. Other potential chemical agents include vesicants, cyanide, pulmonary agents such as chlorine or phosgene and riot-control or lacrimating
(tear-gas) agents (Table 3). Because nerve agents and cyanide have specific antidotes, while nerve agents and vesicants pose a significant contamination hazard to pre-hospital and in-hospital personnel, these are the chemicals focused upon here (see also Chapter 8, Decontamination). The other agents are highlighted in Table 3. In general, chemical agents can be expected to cause relatively rapid onset of clinical effects, ranging from seconds or minutes (potent nerve agent) to several hours (e.g., skin blistering and eye inflammation after vesicant contact, or pulmonary edema after phosgene exposure).

### Nerve Agents

These agents are organophosphate compounds that act as acetylcholinesterase inhibitors, causing a clinical syndrome similar to that caused by organophosphate pesticide poisoning, though of potentially much greater lethality, and with greater immediate brain injury. Significant vapor exposure causes rapid onset of rhinorrhea (runny nose), miosis (pupil constriction), and dyspnea, due to excessive respiratory secretions and bronchospasm; with severe vapor exposure, this could progress rapidly to coma, seizures, paralysis, apnea and death unless immediate antidotal therapy was provided. The toxidromes commonly associated with nerve agent poisoning are shown in Table 4.

Patients exposed to nerve agent vapor represent a slight contamination hazard to EMS providers, since some “off-gassing” can occur from contaminated hair or clothing. Disrobing and a brief shower with soap and water should suffice for decontamination. For patients exposed to liquid nerve agent, more scrupulous decontamination with thorough soap and water cleansing would be warranted; contaminated clothes and skin would be highly toxic to unprotected caregivers, so appropriate PPE must be worn by involved EMS staff. Mainstays of prehospital care include cardiopulmonary resuscitation (CPR) and adequate provision of oxygen, as well as emergent antidotal therapy and supportive care. Atropine is used to counter excess secretions and bronchospasm compromising respiratory status. Pralidoxime (2-PAM), if used prior to induction of irreversible enzyme changes (“aging”), is particularly effective in reversing muscle weakness (Table 3 details dosing considerations). Benzodiazepines should be used aggressively to control seizures, and may be considered in severe cases even prior to seizure onset.

### Vesicant Agents

Vesicant, or blister, agents, such as mustards and Lewisite, have been used by the military as chemical weapons, and are now feared as potential terrorist agents. There was considerable clinical experience with sulfur mustard as a military weapon in World War I. This agent caused skin blistering, eye injury (conjunctivitis, keratitis) and, with heavier exposures, pulmonary tract inflammation several hours after exposure. In severe cases, bone marrow suppression and gastrointestinal mucosal injury was also observed. Therapy consists chiefly of decontamination as soon as possible after exposure, and supportive care. Mustard-contaminated patients, and their clothing, pose considerable cross-contamination risk to caregivers, and thus require similar precautions to those used in managing liquid nerve-agent victims.

### Cyanide

Cyanide inhibits cellular oxidative metabolism, especially in the brain and heart. Terrorist use would most likely involve a vapor release within an enclosed space. Victims with high vapor exposure would rapidly lose consciousness, convulse, and become apneic, though without the typical muscarinic signs (e.g., excess secretions, bronchospasm, miosis) of the comparably poisoned nerve agent victim. Management begins with CPR and provision of 100% oxygen. In severe cases
antidotal therapy may be of additional benefit. Sodium nitrite is one antidote. However, since it may compromise oxygen delivery in patients whose cellular oxidation is already inhibited, careful dosing based on weight and estimated hemoglobin concentration in pediatric patients must be employed (Table 3). An additional antidote sodium thiosulfate is often added. In mild to moderate cases, sodium thiosulfate alone may be beneficial, and safer than the combination. Recently, hydroxocobalamin, a new, potentially safer cyanide antidote has been approved for use in the United States, and some EMS units may now be stocking this antidote instead of the traditional sodium nitrite/sodium thiosulfate combination.

Radiological/Nuclear Exposure

Experiences from Nagasaki and Hiroshima, Bikini Atoll, Three-Mile Island, and Chernobyl have, unfortunately, given the medical community particular insight on radiological injuries and their potential health effects. Fears of intentional use of such substances to harm the civilian population, including children, have been heightened. Radiological and nuclear terrorism in the pediatric population will result in significantly greater short-term and long-term sequelae versus the adult. Such terrorist attacks may occur via any of four possible scenarios: non-explosive dispersal of radioactive substance (e.g., nuclear waste material), explosive dispersal of radioactive substance (e.g., “dirty-bomb”), attack on a nuclear power plant with subsequent radioisotope release, or the dreaded detonation of a nuclear weapon. The first two of these are currently believed to be most likely, since nuclear power plants are extremely well protected, while state use of nuclear weapons is limited by treaty. Radiation can be detected only with specialized equipment, such as Geiger counters, so in many cases children who have been exposed have no way of knowing their danger. In order to manage the pediatric patient with acute radiation exposure/injury and appreciate the gravity of such an attack, EMS personnel must first review radiation terminology, characteristics, biology and physics.

Types of Exposure, Biology, and Clinical Effects

Radiation exposure can be whole body, partial body (local), and internal (ingestion of contaminated foods or inhalation of radioactive gas) and external (wound contamination and skin absorption), or both. Ionizing radiation results in free radical formation with subsequent breaks in strands of DNA and RNA of affected tissues. Because of damage to the genetic material, rapidly dividing cells (gastrointestinal cells, bone marrow and blood producing cells) are most significantly injured. Clinical radiation health effects are multifactorial, and depend on the type of exposure, dose, duration of exposure, type and amount of shielding, distance from radiation source, frequency of exposure (continuous versus intermittent), history surrounding the exposure (concomitant blast or thermal injury) and age of the patient. As a general rule, the earlier the onset of symptoms, the greater the amount and duration of exposure.

Health outcomes in radiation victims can be viewed as short-term and long-term. Short-term effects occur within days to weeks after exposure, while long-term effects commence months to years later. Short-term effects typically include nausea, vomiting, bone marrow and lymphoid immune system suppression with subsequent bleeding, fluid and electrolyte loss, hypovolemic shock, and mental status change that can progress to death. Long-term effects involve the increased risk for cancer and psychological injury.

Localized radiation injury may occur after handling radioactive substances, commonly involving burns to the hands, upper thighs, and buttocks as a result of touching and carrying radioactive material in pant pockets. Radiation burns present with redness that progresses to blistering and ulceration, which may further progress to tissue damage and death as a result of vascular
insufficiency. Radiation burns differ from thermal burns in that they are somewhat painless and develop over a period of several days.

Whole body irradiation will result in acute radiation syndrome if doses exceed 200 rad (2 Sv). It has a prodromal phase that begins within 6 to 12 hours of exposure, followed by abrupt onset of fever, headache, malaise, nausea, vomiting and diarrhea. An asymptomatic, latent phase then ensues within 24 to 48 hours of the prodromal phase, which may last for 2 weeks or beyond. Following the latent phase is the radiation dose-dependent, manifest illness phase, which includes the gastrointestinal, hematopoietic, and neurovascular syndromes. The gastrointestinal syndrome (mucosal disruption and destruction) is seen within 1 week of the prodromal phase and manifests as recurrent nausea, vomiting and diarrhea with severe metabolic disturbances. The hematopoietic syndrome involves bone marrow and lymphoid immune system suppression. Symptoms include overwhelming infections, bleeding disorders, and death. The neurovascular syndrome runs a fulminant course, and ensues as a result of diffuse central nervous system and blood vessel injury. Within 24 to 72 hours, patients progress from nausea and vomiting to frank prostration to shock and seizures to cerebral edema and other central nervous system complications, resulting in death. Patients in whom nausea and vomiting begin within 4 hours of exposure rarely if ever survive.

Pediatric Vulnerabilities

Children are susceptible to radiation injury for many reasons. Compared to adults, children breathe at a faster rate and are likely to have inhaled a greater amount of radioactive gases were there to be radioactive gas release. Nuclear fallout tends to settle to the ground (a zone familiar to children) resulting in a higher concentration of radioactive material in the space that children inhabit. Both breast and cow milk are main sources of nutrition for children. Exposure to radioactive iodine via ingestion of milk from cows whose grazing areas have been contaminated by fallout, or inhalation or ingestion of milk from nursing mothers exposed to fallout, would place children at risk for internal contamination, and possible development of thyroid cancer in the young child over time. Small head circumference and mental retardation may manifest in the unborn child if a pregnant woman is exposed to radioactive iodine. As alluded to previously, children exposed to similar doses as the adult, are more likely to develop radiation-induced cancers. Psychological and behavioral disturbances are also more likely in children after any traumatic event.10,11

Immediate Management

Radiation disasters require Federal, state, and local government intervention in addition to EMS, and would involve one or more of the following: evacuation, sheltering in place, and, if radioactive fallout is expected, administration of potassium iodide. Such detailed planning is beyond the scope of this chapter.

It is important for providers to minimize the time spent at or near the detonation site during rescue operations as a radiation event. It is also important to maximize distance from the source of radiation: doubling distance reduces exposure by 75%; tripling distance reduces it by almost 90%. Since radiation travels in straight lines, some radiation is blocked by concrete or other building materials. If circumstances permit, EMS providers should position themselves so that the source of radiation is around the corner of a building, or far enough away so that several large buildings are between them and the source.

Emergency management of radiation injury involves the following primary objectives: maintaining the ABC’s (airway, breathing, and circulation); reducing the risk of internal contamination; recognizing and treating acute radiation syndrome; minimizing radioactive contamination and spread to the caregiver and others. Disaster management principles should be
instituted and include containment, decontamination, prehospital care, and field triage. Patients should be decontaminated in the field and then transported to the medical treatment facility. Persons caring for pediatric radiation victims should, by dosimeter or history, determine whether the victim is contaminated (deposition of radioactive material internally or externally) or irradiated (exposure to a source of radiation, i.e., γ-rays or x-rays, that does not render the victim radioactive).

Contaminated victims require decontamination and should have all clothing removed (disrobingment), as this accomplishes greater than 90% effective decontamination. However, since the risk of exposure to properly garbed health care providers is minimal, resuscitation should precede decontamination if the patient is in extremis. Personnel caring for contaminated patients should observe universal precautions, wearing protective masks, gowns, gloves and plastic shoe covers or booties. Patients should be wrapped in cloth sheets to minimize contamination of personnel and the medical treatment facility. Contaminated clothing and material should be placed in designated containers or areas. If determined that the victim requires topical decontamination, the skin should be washed with warm water and soap while avoiding the development of hypothermia. Particles tend to become lodged in the skin folds, under the fingernails, behind and around the ears, hair, hands and face. Open wounds should be covered so as not to contaminate wounds. Patients with skin burns require irrigation only; avoid abrading the skin. All irrigation solutions should be collected in designated containers and properly disposed. Decontamination zones and treatment areas should have controlled access. Once decontamination is complete, patients may be transported to the medical treatment facility. It should be abundantly clear that in life-threatening situations, priority is given to establishing and maintaining the ABC’s, followed by rapid transport to the hospital with as lengthy a pre-notification as possible.

Pediatric victims without evidence of external contamination may be treated according to standard protocol, but their bodily fluids may be contaminated, hence require special handling precautions.

Management of local radiation burn and acute radiation syndrome is mainly supportive. If surgical intervention for local burn is warranted, it should be performed within 48 hours of irradiation to afford good wound healing and prevent infection. Acute radiation syndrome victims will usually become symptomatic within a few hours to days after initial exposure. However, for the exposed prehospital provider, symptoms will likely begin a few days to weeks after the patients they transported were initially hospitalized or evaluated.

Although the optimal treatment for internal contamination requires knowledge of the specific contaminant and the sophistication offered at a medical treatment facility, the prehospital provider may only have potassium iodide (KI) available. KI should be used in a scenario that involves detonation of a nuclear weapon, attack on nuclear reactor or power plant meltdown. Guidance to EMS personnel from the Federal government and state of local departments of health will determine when to administer KI and whether or not EMS personnel should stock KI on their daily missions. For further information on KI, the reader is directed to the references at the end of this chapter. Other radioactive substances can cause internal contamination, but specific treatment will require expert consultation, and is therefore, not addressed in this chapter.

**Explosive/Blast Injuries**

Emphasis on terrorism preparedness has mainly focused on chemical, biological, radiological, and nuclear events, while explosive events, according to some authors, have been neglected. Whether this belief is true or is not, it is established fact that physical injury is responsible for 98% of terror events worldwide, with bomb blasts accounting for 75%, and firearms for 23%. It is also well-known that instructions on how to build a bomb are readily available via the internet. In addition, raw materials to further such causes are easily obtained. It is therefore not surprising that most
terrorist attacks to date involve explosive devices, and that the frequency of bombing directed at civilians is increasing.\textsuperscript{13,14} Most of the mass-casualty terrorist events in the United States have involved the use of conventional explosives.\textsuperscript{15} Experiences from Israel, Northern Ireland, Iraq, Afghanistan, and other countries, including the United States (Oklahoma City bombing and September 11 suicide airliner attacks on New York and Washington) have raised awareness among non-military prehospital personnel, health professionals, and clinicians; it augmented their understanding of blast injuries and its spectrum.

**Bomb Types and Characteristics**

Terrorist bombs are designed to detonate in crowded areas, typically optimizing injury severity and fatality through release of metallic fragments (often called shrapnel, an outmoded term that refers to a particular type of metallic fragment commonly used in World War I). These bombs are of three main types: suicide bombs, package bombs, and vehicle bombs.

Suicide bombs are unique because they result in intentional death of the bomber, are more likely to be successful as they evade detection (hidden on the person), and are difficult to prevent. Risk of transmission of blood-borne infections (e.g., hepatitis B or C) in patient survivors of a suicide bombing is possible; although there are few anecdotal cases of such transmission (transmission of HIV has not been reported to date).

Car bombs involve heavy explosive material, produce big blasts, and often culminate in infrastructure damage and collapse. Hundreds of victims will result. Many patients will require extrication or some form of technical rescue and treatment for crush injury or crush syndrome. When part of the patient’s body is trapped under pressure, dangerous chemicals and toxins accumulate in the crushed body part after a long period of compression. When the limb or other body part is released, a severe shock-like condition follows which is characterized by swelling, blood in the urine, and ultimately kidney failure. To prevent this, intravenous fluids and sodium bicarbonate should be administered before extrication. During extrication, the patient should be monitored for changes in mental status. It is also important to maintain blood sugar levels and keep the patient warm to prevent hypothermia. Car bombs are most likely to be incendiary, producing burn injuries in patients as a result of secondary fires.

Package bombs are smaller in size by nature as they are carried into an attack site. They are easy to delivery and usually in confined places (e.g., bus, section of a building). Although package or letter bombs are smaller, the fact that they are detonated in a confined (closed) space results in magnifying the resultant injury (see blast physics section below).

**Blast Physics**

When a bomb is activated, the explosive chemical rapidly converts from a solid or liquid state to a gaseous state, which now occupies a significantly greater volume of space than before the explosion. A rapidly expanding “blast wave” (instantaneous overpressure followed immediately by underpressure) and “blast wind” (ensuing rapid air currents) then project outward in all directions and occur within milliseconds. The processes of over- and under-pressurization and subsequent rapid air currents occur at different speeds depending on the type of explosive.\textsuperscript{16} When treating victims of a bomb, it is important to know where it exploded (open or confined space) as this may anticipate the number, type, and intensity of injuries observed.

High-pressure blast wave from a detonation exerts a compressive force on air molecules and moves these air molecules through the environment. The blast wave exerts a crushing external force on any object in its path; the effect is one of being first compressed, then exposed to low-pressure
(vacuum), and then back to a normal pressure.\textsuperscript{17} In essence, the blast wave and wind involves a squeezing, releasing, and re-squeezing mechanism.

Injury severity is directly related to the distance between the victim and the explosion site—the closer to the explosion, the greater the extent of injury.\textsuperscript{18} Walls and ceilings, especially enclosed areas (e.g., buses, cafes), augment and amplify the “over-pressure effects” as they reflect the blast waves. Other factors that may determine the extent of injury include body mass of the victim (grave implications for young children), orientation of the victim to the blast, and shielding present between the victim and the blast.\textsuperscript{19,20}

**Types of Blast Injuries and Blast Pathophysiology**

Blast injuries are classified into four categories based on the mechanism of injury (blast effects): these are referred to as primary, secondary, tertiary, and quaternary. As mentioned previously, the types of injuries caused by blast depend on numerous factors, but the key factors are whether the blast caused structural damage with collapse of the structure or other structures, and whether it occurred in open air or within a building.

**Primary blast injuries** are a result of over-pressurization (blast wave). In this scenario, air-filled organs are subject to the worst damage from high external overpressure of an explosive blast. It is the effect of the blast wave at the air-body interface, especially at zones of differential tissue densities and air-filled organs (e.g., ear, lung, and intestines).\textsuperscript{17} Forms of primary blast injury include the following:

**Auditory blast injury:** Tympanic membrane rupture is the most frequent primary blast injury. Contrary to popular belief, it poorly correlates with blast injury elsewhere in the body, and some authors say it is of no use as a predictive marker.\textsuperscript{15,17} Patients may present with symptoms including deafness, ringing in the ear, and vertigo. Bones in the middle ear may be dislocated as well. Further damage may lead to long term deafness.

**Blast Lung:** The lung is the second most frequent organ injured in primary blast injury, and is the most common critical injury to persons close to a blast center.\textsuperscript{15} The alveolar-capillary interface is disrupted by the blast wave, culminating in bruising of the lung tissue (pulmonary contusion), blood in the lungs (hemotherox), air leak and compression of the lungs (pneumothorax and/or pneumomediastinum), and lung blebs (surface blisters). These potential life-threatening lung injuries can rapidly progress to pulmonary edema (wet “drowning” lungs) with frothing at the mouth; it results from pressure differentials forcing fluid out of the capillaries into the air-sacs or spaces. Patients usually complain of cough, difficulty breathing, and retrosternal chest pain. Cough is initially dry in nature, but may progress to productive frothy type, or frank blood. On physical examination, patients have rapid respiratory rate, cyanosis (blue spell), decreased breath sounds, and diffuse rhonchi or coarse breath sounds. Pulse oximetry may reveal low oxygen saturation. Other findings as a result of lung injury are brain or spinal cord blood vessel occlusion secondary to acute systemic air embolism from lung disruption. Patients may present with stroke-like symptoms.

**Cardiac blast injury:** Similar to blunt chest trauma, cardiac blast injury involves mainly contusions (bruises). Arrhythmias like ventricular fibrillation, ventricular tachycardia, bradycardia, and asystole have been reported in the medical literature. Hypotension and bradycardia have also been reported and is thought to be secondary to direct blast wave effect on disrupting compensatory vasoconstriction.\textsuperscript{17} Cardiac blast injury related death is thought to be a result of air emboli within the coronary circulation.\textsuperscript{15} Cardiac monitoring is critical in this subset of patients.
Abdominal blast injury: Although relatively more common in underwater blasts and occult in presentation, abdominal blast injury may result in overt bowel rupture. Very high energy blasts or close proximity can result in rupture and bleeding of solid organs like the kidney, liver, and spleen.

Orthopedic primary blast injury (Traumatic amputation): Traumatic amputation occurs when the blast wave that passes through shaft of long bones, causes bone failure, and the dynamic blast overpressure separates the fractured extremity.\textsuperscript{15,21} It is a potential marker of severe blast exposure, is rare in blast survivors, and is distinguished from that obviously caused by a secondary fragment or flying object (discussed later under tertiary blast injury).\textsuperscript{22}

Other primary blast injuries include eye injuries (e.g., hyphema and globe rupture); facial fractures; concussion and traumatic brain injury.

Secondary blast injuries are a result of “blast winds” that cause objects to strike the victim. Injuries are secondary to blunt trauma or penetration of energized, usually metallic, fragments or debris. Except in cases of major building collapse, penetrating injuries from fragments are the leading cause of death and injury in both military and civilian terrorist attacks.\textsuperscript{14} Fragments usually do not pass through the victim; they are multiple and retained in the body. Clothing does offer slight protection against these projectile fragments, but exposed skin surfaces will likely be traumatized with minor cuts, bruise and penetrations. Injuries can be expected mainly on exposed area of the body—hands, head and neck. Other injuries that may be anticipated include perforated hollow organs, collapsed lungs, or lacerated and bleeding internal organs. Comminuted fractures of the longs bones also may be noted.

Tertiary blast injuries are wounds sustained from acceleration-deceleration forces that occur as the “blast wind” propels the victim against a fixed object. Any body part can be involved, resulting in brain injury, traumatic amputation, and fractures. Although traumatic amputation results from a combination of primary and tertiary effects, it is extremely rare in survivors, as traumatic amputees usually die from significant blast wave effects, and rapid exsanguination from blood vessel disruption.\textsuperscript{15,17} In addition, structural collapse contributes to tertiary injuries, in that it involves large airborne fragments, subsequent crush injury or crush syndrome (defined above), compartment syndrome (compression from swelling of damaged muscle tissue within its elastic sheath that promotes local tissue death; the patient usually has pain that is out of proportion to the injury), and extensive blunt trauma.

Quaternary blast injuries are explosion-related injuries or disease not related to primary, secondary, or tertiary injuries. It commonly involves thermal or chemical burns, inhalational injury, asphyxiation (e.g. from carbon monoxide or cyanide), radiation exposure, and psychological effects. Burns are usually on skin-exposed areas as mentioned previously. Psychological effects have significant impact on children and are evident in both survivors and non-exposed children.

Management

The most important priority after an explosion or terrorist bombing is scene control, with emphasis on safety—particularly the avoidance of injuries to bystanders and rescuers from secondary device explosion. Prehospital triage may begin on the scene, if appropriate, but in some cases the “scoop and run” approach might be warranted (i.e., minimal medical intervention on scene with rapid evacuation to the nearest medical treatment facility). The primary goal of prehospital personnel should be to protect the critically injured but salvageable patients by ensuring that they are evacuated first. Each subsequent evacuee should be the next most critical patient. It is paramount that no casualty is overlooked.
Guidelines for the prehospital care of a general trauma victim and that of a bomb victim do not differ significantly. Rapid triage following basic field medical care guidelines may increase the chance of survival of the potentially salvageable critically injured patient as it augments rapid evacuation by mitigating wasted efforts on patients not salvageable. These guidelines are as follows: victims with amputated body parts and no signs of life are considered dead; victims without breathing or pulse and having dilated pupils are dead; CPR should not be done on scene; airway management with cervical immobilization is paramount; supplemental oxygen administration and/or needle decompression of chest, application of direct pressure or tourniquets, alignment of fractures, limb-to-limb splinting, and coverage of open wounds are performed as necessary.\textsuperscript{13,23}

The initial stabilization of victims of blast injury involves prompt attention to the “ABC” concept of managing the airway, breathing and circulation. Depending on the age of the pediatric patient, intravenous fluid infusion should be initiated only to maintain adequate blood pressure, recognizing that such an intervention consumes valuable time that may be far better used attending to other victims. When used, however, the aforementioned risk of pulmonary edema and renal failure in patients with blast lung or crush injuries must be carefully considered and fluid infusion judiciously balanced to avoid both hypoperfusion and overhydration. Pulse oximetry and cardiac monitoring may also reveal possible oxygen exchange problems resulting from lung injury or arrhythmias associated with heart injury. Extremity fractures should be splinted while wounds and burns should be covered with sterile dressings to prevent contamination, heat and insensible fluid loss. Pressure dressing/packs should be placed on any active bleeding sites. Penetrating objects to eye and other parts of the body should not be removed, but left in place.\textsuperscript{14}

Special Considerations

If a disaster is widespread or prolonged, emergency response times may be delayed due to high demand, transport restrictions, or overloaded care facilities; therefore, EMS providers may be treating injuries later in their course than they are usually accustomed to. Consequently there may be an increase in the incidence of shock and infections associated with wounds.

Summary

In general, prehospital providers will be first on the “scene” when a terror event occurs, and should have some general understanding of the various Chemical, Biological, Radiological, Nuclear, and Explosive/Incendiary (“CBRNE”) agents likely to be encountered, in addition to medical disaster management strategies in this acute setting. It is evident that there are enormous gaps in knowledge and experience with pediatric patients and their unique qualities among EMS providers. Continuing education and reviews on such pediatric topics must be an integral part of professional development. It is of paramount importance to recognize that rapid response coupled with appropriate treatment will likely increase patient survival.
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Federal Emergency Management Agency (consequence management) www.fema.gov
FEMA (202) 646-4600

US Military Agency Resources (educational and practical resources)
US Army Medical Research Institute of Infectious Disease www.usamriid.army.mil
US Army Medical Research Institute of Chemical Defense www.chemdef.apgea.army.mil
US Armed Forces Radiobiology Research Institute www.afrri.usuhs.mil

Center for Disease Control (at request of state/territory agency, clinical resource) www.bt.cdc.gov
Emergency Response Hotline (770) 488-7100

Center for Civilian Biodefense Strategies www.hopkins-biodefense.org

Nuclear, biological, chemical resources www.nbcm-ed.org

The Radiation Emergency Assistance Center/ Training Site (REAC/TS) www.orau.gov/reacts
(865)576-3131 ask for REACT/TS

Poison Control Centers (800-222-1222)

### Table 3. Primary Chemical Agents

<table>
<thead>
<tr>
<th>Agent</th>
<th>Toxicity</th>
<th>Clinical Findings</th>
<th>Onset</th>
<th>Decontamination(^1)</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nerve agents:</td>
<td>Anticholinesterase</td>
<td>Vapor: miosis, rhinorrhea, dyspnea</td>
<td>Seconds: vapor</td>
<td>- ABCs</td>
<td>- Tabun: 0.05 mg/kg IV(^2) (\text{min} 0.1 \text{mg}, \text{max} 5 \text{mg}), repeat q2-5 min prn for marked secretions, bronchospasm</td>
</tr>
<tr>
<td>Tabun, Sarin,</td>
<td>muscarinic, nicotinic and CNS effects</td>
<td>Liquid: Diaphoresis, vomiting</td>
<td>Minutes-hours: liquid</td>
<td>- Pralidoxime: 25 mg/kg IV, IM(^3) ((\text{max} 1 \text{g IV; 2 g IM})), may repeat within 30-60 min prn, then again Q1 hr for 1 or 2 doses prn for persistent weakness, high atropine requirement</td>
<td></td>
</tr>
<tr>
<td>Soman, VX</td>
<td></td>
<td>Both: coma, paralysis, seizures, apnea</td>
<td></td>
<td>- Diazepam: 0.3 mg/kg (max 10 mg) IV; Lorazepam: 0.1 mg/kg IV, IM (max 4 mg); Midazolam: 0.2 mg/kg (max 10 mg) IM prn seizures, or severe exposure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ABCs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Atropine: 0.05 mg/kg IV(^2), IM(^1) ((\text{min} 0.1 \text{mg}, \text{max} 5 \text{mg})), repeat q2-5 min prn for marked secretions, bronchospasm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pralidoxime: 25 mg/kg IV, IM(^3) ((\text{max} 1 \text{g IV; 2 g IM})), may repeat within 30-60 min prn, then again Q1 hr for 1 or 2 doses prn for persistent weakness, high atropine requirement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diazepam: 0.3 mg/kg (max 10 mg) IV; Lorazepam: 0.1 mg/kg IV, IM (max 4 mg); Midazolam: 0.2 mg/kg (max 10 mg) IM prn seizures, or severe exposure</td>
<td></td>
</tr>
<tr>
<td>Vesicants:</td>
<td></td>
<td></td>
<td></td>
<td>ABCs</td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>Alkylation</td>
<td>Skin: erythema, vesicles</td>
<td>Hours</td>
<td>- Skin: soap and water</td>
<td>- Symptomatic care</td>
</tr>
<tr>
<td>Lewisite</td>
<td>Arsenical</td>
<td>Eye: inflammation</td>
<td></td>
<td>- Eyes: water</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiratory tract: inflammation</td>
<td>(immediate pain with Lewisite)</td>
<td>(both: major impact only if done within minutes of exposure)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(possibly BAL 3 mg/kg IM Q4-6hrs for systemic effects of Lewisite in severe cases)</td>
<td></td>
</tr>
<tr>
<td>Pulmonary</td>
<td></td>
<td>Eyes, nose, throat irritation (especially chlorine)</td>
<td>Minutes: eyes, nose, throat irritation, bronchospasm; Hours: pulmonary edema</td>
<td>Fresh air</td>
<td>- Symptomatic care</td>
</tr>
<tr>
<td>agents:</td>
<td></td>
<td>Respiratory: bronchospasm, pulmonary edema (especially phosgene)</td>
<td></td>
<td>Skin: water</td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>Liberate HCL, alkylation</td>
<td></td>
<td></td>
<td>ABCs, 100% oxygen</td>
<td></td>
</tr>
<tr>
<td>Phosgene</td>
<td></td>
<td></td>
<td></td>
<td>Na bicarbonate prn metabolic acidosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Na nitrite (3%): Dose (ml/kg) \begin{align*} 0.27 &amp; 10 \ 0.33 &amp; 12 \text{ (est. for average child)} \ 0.39 &amp; 14 \text{ (max 10 ml)} \end{align*}</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Na thiosulfate (25%): 1.65 ml/kg (max 50 mL)</td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>Cytochrome oxidase inhibition: cellular anoxia, lactic acidosis</td>
<td>Tachypnea, coma, seizures, apnea</td>
<td>Seconds</td>
<td>Fresh air</td>
<td>- ABCs, 100% oxygen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Skin: soap and water</td>
<td>- Na bicarbonate prn metabolic acidosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Na nitrite (3%): Dose (ml/kg) \begin{align*} 0.27 &amp; 10 \ 0.33 &amp; 12 \text{ (est. for average child)} \ 0.39 &amp; 14 \text{ (max 10 ml)} \end{align*}</td>
<td>- Na thiosulfate (25%): 1.65 ml/kg (max 50 mL)</td>
</tr>
</tbody>
</table>
### 13: Physical Disasters

**Pediatric Disaster Preparedness**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Toxicity</th>
<th>Clinical Findings</th>
<th>Onset</th>
<th>Decontamination</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riot Control agents:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS</td>
<td>Neuropeptide substance P</td>
<td>Eye: tearing, pain, blepharospasm</td>
<td>Seconds</td>
<td>Fresh air</td>
<td>Ophthalmics topically, symptomatic</td>
</tr>
<tr>
<td>CN (Mace⁴)</td>
<td>alkylation</td>
<td>Nose and throat irritation</td>
<td></td>
<td>Eyes: lavage</td>
<td>care</td>
</tr>
<tr>
<td>Capsaicin</td>
<td></td>
<td>Pulmonary failure (rare)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Decontamination, especially for patients with significant nerve agent or vesicant exposure, should be performed by health care providers garbed in adequate personal protective equipment. For ED staff, this consists of non-encapsulated, chemically-resistant body suit, boots and gloves with a full face air purifier mask/hood. (See also Chapter 8).

2 Intraosseous route is likely equivalent to intravenous.

3 Atropine might have some benefit via endotracheal tube or inhalation, as might aerosolized ipratropium. As of July 2004, the FDA has approved pediatric autoinjectors of atropine in 0.25, 0.5 and 1 mg sizes. FDA recommendations are:

<table>
<thead>
<tr>
<th>Approx Age</th>
<th>Approx Wt</th>
<th>Autoinjector size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6 mos</td>
<td>&lt; 15 lbs</td>
<td>0.25 mg</td>
</tr>
<tr>
<td>6 mos – 4 yrs</td>
<td>15-40 lbs</td>
<td>0.5 mg</td>
</tr>
<tr>
<td>5-10 yrs</td>
<td>41-90 lbs</td>
<td>1 mg</td>
</tr>
<tr>
<td>&gt; 10 yrs</td>
<td>&gt; 90 lbs</td>
<td>2 mg (adult-sized)</td>
</tr>
</tbody>
</table>

4 Pralidoxime is reconstituted to 50 mg/ml (1 g in 20 ml water) for IV administration, and the total dose infused over 30 min, or may be given by continuous infusion (loading dose 25 mg/kg over 30 min, then 10 mg/kg/hr). For IM use, it might be diluted to a concentration of 300 mg/ml (1 g added to 3 ml water - by analogy to the US Army’s Mark 1 autoinjector concentration), in order to effect a reasonable volume for injection. Pediatric autoinjectors of pralidoxime are not FDA approved or available at this time. The Mark 1 autoinjector kits contain 2 mg (0.7 ml) atropine, and 600 mg (2 ml) pralidoxime, delivered into two separate intramuscular sites; while not approved for pediatric use, the pralidoxime autoinjector might be considered as initial treatment in dire (especially pre-hospital) circumstances, for children with severe, life-threatening nerve agent toxicity who lack intravenous access, and for whom more precise, mg/kg IM dosing would be logistically impossible. Suggested dosing guidelines are offered; note potential excess of initial pralidoxime dose for age/weight, though within general guidelines for recommended total over first 60-90 min of therapy of severe exposures:

<table>
<thead>
<tr>
<th>Approximate Age</th>
<th>Approximate Weight</th>
<th>Number of Autoinjectors</th>
<th>Pralidoxime dose range (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-7 yrs</td>
<td>13-25 kg</td>
<td>1</td>
<td>24-46</td>
</tr>
<tr>
<td>8-14 yrs</td>
<td>26-50 kg</td>
<td>2</td>
<td>24-46</td>
</tr>
<tr>
<td>&gt;14 yrs</td>
<td>&gt;51 kg</td>
<td>3</td>
<td>35 or less</td>
</tr>
</tbody>
</table>

Key: ABCs = airway, breathing and circulatory support; BAL = British Anti-Lewisite; Hgb = hemoglobin concentration; est. = estimated hemoglobin concentration; max = maximum; min = minimum; prn = as needed.

Note: some authorities recommend simplified strategies for use of autoinjected pediatric nerve agent antidotes in children with exposure and signs of significant toxicity, such as:

<table>
<thead>
<tr>
<th>Age</th>
<th>Atropine (mg)</th>
<th>2-PAM (600 mg = 1 adult autoinjector)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 yr</td>
<td>0.5</td>
<td>none</td>
</tr>
<tr>
<td>1-8 y</td>
<td>2</td>
<td>600 mg</td>
</tr>
<tr>
<td>&gt;8 y</td>
<td>(as per adult)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Classic toxidromes associated with cholingeric crisis due to nerve agents

<table>
<thead>
<tr>
<th>SLUDGEM*</th>
<th>DUMBELS*</th>
<th>MTW(t)HF†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salivation</td>
<td>Diarrhea, Dyspnea, Diaphoresis</td>
<td>Mydriasis</td>
</tr>
<tr>
<td>Lacrimation</td>
<td>Urination</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>Urination</td>
<td>Miosis</td>
<td>Weakness</td>
</tr>
<tr>
<td>Defecation</td>
<td>Bradycardia, Bronchorrhea, Bronchospasm</td>
<td>(t)Hypertension</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Emesis</td>
<td>Fasciculations</td>
</tr>
<tr>
<td>Emesis</td>
<td>Lacrimation</td>
<td></td>
</tr>
<tr>
<td>Miosis</td>
<td>Salivation, Secretions, Sweating</td>
<td></td>
</tr>
</tbody>
</table>

*Muscarinic effects (treated with atropine)
†Nicotinic effects
Chapter 14: Biological Disasters

Stephan Kohlhoff MD, Daniel Fagbuyi MD, Fred Henretig MD

Introduction

Prehospital providers are usually first on the “scene” when an incident occurs or a patient is in urgent need of medical attention, but this may not necessarily be the case when it comes to biological agents. Nonetheless, prehospital providers should be cognizant not only of the unique characteristics of children, but also the various types, clinical features, and acute management of biological agent exposure in the pediatric population.

Biological terrorism may be defined as the deliberate release of viruses, bacteria, or other germs (vectors) used to cause illness or death in people, animals, or plants to cause disease, death, destruction, or panic for political or social gains. Biological agents are divided into categories of highest to lowest priority by the Centers for Disease Control and Prevention, or CDC (http://www.cdc.gov). Category A agents are of highest priority, easily spread or transmitted from person to person, result in high mortality, and may cause public panic and social disruption; these agents pose the highest risk to the public and national security. In addition, they are easily manufactured and deployed without sophisticated delivery systems, and have the ability to kill or injure hundreds or thousands of people. A unique and challenging feature that distinguishes a biological exposure from other types of exposure (chemical, radiological, nuclear, explosive & incendiary), is the delay in the onset of illness (hours to days vs. seconds to minutes) associated with biological weapons.1,2 This unique feature elucidates how illness from biological agents may go unrecognized, present to the “non-traditional” first responder (pediatrician or tertiary facility), and culminate in widespread secondary exposure over large geographic areas.

Category A agents include anthrax, plague, botulinum toxin, smallpox, tularemia, and viral hemorrhagic fevers (filoviruses or arenaviruses). These are summarized in Table 2. The reader is directed to several relevant internet websites noted in Table 1 for a more detailed description of other category agents, which are beyond the scope of this section.

General Guidelines for Pediatric Infection Control

When caring for children displaying symptoms thought to be due to a biological agent, current Healthcare Infection Control Advisory Committee (HICPAC) Guidelines should be applied (the 2007 Guidelines for Isolation Precautions in Hospitals were in force at the time of this writing).2 Note that recommendations (such as duration of isolation) sometimes differ between adults and children.

Transmission of an infectious agent requires three elements: a source (or reservoir) of infectious agents, a susceptible host with a port of entry receptive to the agent, and a mode of transmission for the agent. Modes of transmission vary by type of organism, and are divided into three major categories: contact (direct or indirect), droplet, or airborne. Table 1 indicates precautions by disease. Whenever available, a clinical case definition for exposed/symptomatic and exposed/asymptomatic children, to be provided by local health officials, should be applied. Exposure to a known biological agent may not be always recognized. For patients who have symptoms that are consistent with the biological agent in question, precautions should be instituted according to guidelines. Asymptomatic patients with possible exposure are less likely to be contagious, although specific guidelines for their evaluation and precautions may apply depending on the agent. The
goal is to promptly evaluate and separate unexposed and exposed/asymptomatic children as soon as possible from symptomatic children and symptomatic adults. While there is a known risk of transmission of infectious agents from infected children to caregivers, the presence of caregivers (asymptomatic or symptomatic) may be in the best interest of the child (asymptomatic or symptomatic). In order to minimize risk of transmission caregivers have to be instructed in relevant isolation and care procedures.

For all children who are symptomatic and suspected of being infected with an agent of concern, the following measures may need to be applied in addition to standard precautions:

- HICPAC isolation guidelines: Apply guidelines appropriate to the nature of the illness/exposure
- Droplet precautions: Use of surgical face masks as source containment (e.g. during transport) is inappropriate in infants; it may be possible to instruct toddlers in a age-appropriate manner to wear masks if constant supervision is possible
- Respiratory hygiene/cough etiquette: This should be emphasized as an alternative to masking
- Airborne precautions: Care providers need to use N95 or higher respirator, gloves and gown

Droplet, airborne, and contact precautions should be combined for diseases caused by organisms that have multiple routes of transmission.

There are some special concerns regarding respiratory precautions in children. While there are no masks or respirators designed to fit children, small-sized respirator face pieces may adequately fit older children. While surgical masks are not required to fit as tightly to the face, they should not interfere with eyesight, and gaps should be minimized. The likelihood that a child would use a facemask or a respirator properly is a significant concern. Facemasks and respirators will not serve their intended purpose if they are not worn during appropriate times. Children may not understand the importance of wearing a mask, and they may not tolerate having them on their faces for extended periods of time. Because handling used facemasks and respirators could also transmit the influenza virus, wearers should be trained in how to remove and dispose of them safely. Careful handling of a contaminated mask or respirator may not be a reasonable expectation of young children.

Any space occupied by patients should be decontaminated; laundry and waste should be discarded into biohazard bags; and laundry and bedding should be laundered in hot water with laundry detergent, followed by hot air drying or incinerated.

**Infections: Unknown biologic agent**

**Recognition of Illness Associated with the Intentional Release of a Biologic Agent**

Health-care providers should be alert to illness patterns and diagnostic clues that might indicate an unusual infectious disease outbreak associated with intentional release of a biologic agent and should report any clusters or findings to their local or state health department. The covert release of a biologic agent may not have an immediate impact because of the delay between exposure and illness onset, and outbreaks associated with intentional releases might closely resemble naturally occurring outbreaks. Indications of intentional release of a biologic agent include...
• unusual temporal or geographic clustering of illness (e.g., persons who attended the same public event or gathering)

• patients presenting with clinical signs and symptoms that suggest an infectious disease outbreak (e.g., >2 patients presenting with an unexplained febrile illness associated with sepsis, pneumonia, respiratory failure, or rash or a botulism-like syndrome with flaccid muscle paralysis, especially if occurring in otherwise healthy persons)

• unusual age distribution for common diseases (e.g., an increase in what appears to be a chickenpox-like illness among adult patients, but which might be smallpox)

First responders play a critical role in recognizing and responding to illnesses caused by intentional release of biologic agents. Becoming familiar with the following syndrome descriptions may help recognizing an event and implementing appropriate precautions.

**Bioterrorism Category A Agents**

The United States Centers for Disease Control and Prevention (CDC) has defined those agents as Category A agents that are easily disseminated or transmitted from person to person, result in high mortality, can cause social disruption, require special public health interventions and pose the greatest risk for national safety.

At the time of this publication the agents of highest concern (Category A) are the following bacteria, viruses, and toxins: *Bacillus anthracis* (anthrax), *Yersinia pestis* (plague), and *Francisella tularensis* (tularemia); variola major (smallpox), and the viral hemorrhagic fever filoviruses (Ebola hemorrhagic fever, Marburg hemorrhagic fever) and arenaviruses (Lassa [Lassa fever], Junin [Argentine hemorrhagic fever], and related viruses); and *Clostridium botulinum* toxin (botulism).

The following paragraphs give a short description of the clinical manifestations in children; modes(s) of transmission, precautions and preventive measures are summarized in Table 1.

**Bacterial Agents**

**Anthrax**

Aerosolization would be the likely method of release if used as a biological weapon. *Bacillus anthracis* is the causative agent. Natural human disease occurs after exposure to infected animals or products. There are 3 forms of anthrax—cutaneous, gastrointestinal, and inhalational.

**Cutaneous anthrax** results from inoculation of anthrax spores into broken skin, and starts as a pruritic (itchy), painless papule (raised skin lesion) that rapidly progresses through various stages from papule to vesicle to blister to painless, deep, necrotic ulceration with eschar (scab) formation on a background of edema (swelling), induration (stiffness), and erythema (redness).

**Gastrointestinal anthrax** results from ingestion of anthrax spores (undercooked meat). Patients are usually symptomatic within less than one week after ingestion. Signs and symptoms include nausea, vomiting, fever, abdominal pain, bloody diarrhea or hematemesis (bloody vomiting), ulcerating lesions at the tongue base, dysphagia, and systemic symptoms.

**Inhalational anthrax** is a biphasic illness with an incubation period of one to six days, although it can take as long as sixty days to become manifest.³ Phase 1 commences with a prodrome of influenza-like symptoms, including fever, myalgia, cough, malaise or fussiness, and chest or
abdominal pain. Rhinorrhea (runny nose) is rare (<10%); this may be a useful distinguishing feature from viral upper respiratory tract infections when faced with multiple cases requiring rapid triage.\(^2,3\) Phase 2 begins with persistent worsening fever and chest pain, subsequent dyspnea, diaphoresis, and cyanosis, with rapid progression to shock and death within 24-36 hours. Inhalational anthrax is complicated by meningitis in 50\% of cases. There are no specific physical exam findings.

Person-to-person spread of anthrax has not been reported, but standard precautions should be observed and are considered to be sufficient.\(^3,4\) Sporicidal agents (e.g., sodium hypochlorite, or household bleach) may be used to decontaminate and disinfect invasive instruments and proximate environment (e.g., body fluids spills, spores).

A case of cutaneous anthrax in a 7-month-old child during the recent outbreak in the United States highlighted the additional features usually not seen in adults: fever, edema, renal failure, disseminated intravascular coagulation (widespread microscopic clotting of small blood vessels), and other hematologic abnormalities.\(^5\)

**Plague**

Aerosolization would be the likely method of release if used as a biological weapon. *Yersinia pestis* is the causative agent. Natural spread to humans occurs via the bite of an infected flea. Plague is extremely contagious and manifests three clinical syndromes—pneumonic (pneumonia), bubonic (swollen lymph nodes), and septicemic (systemic infection).

After an incubation period of about two to four days (range 1-6 days), pneumonic plague starts with an abrupt onset of fever, chills, malaise, myalgias, nausea, vomiting, abdominal pain, diarrhea, hemoptysis (cough blood), and cyanosis that rapidly progresses to respiratory failure and shock.

When naturally occurring plague manifests as the bubonic plague type, it is heralded by acute febrile illness with tender, swollen lymph nodes (called “buboes”, usually found in the inguinal region) with overlying skin redness.

Septicemic plague is similar to gram-negative sepsis (systemic infection caused by enteric, i.e., gastrointestinal, organisms). Patients present with high fever, chills, malaise, nausea, vomiting, diarrhea, and hypotension, but progress to shock in the setting of thrombosis, necrosis, gangrene, disseminated intravascular coagulopathy (DIC) and death, if untreated. Other findings on exam include black necrotic extremities and proximal purpuric (blotchy purple) lesions.\(^6\)

All forms of plague can progress to the septicemic form, which can spread to any organ system. As with most biological agents the early diagnosis requires a high index of suspicion. Large numbers of previously healthy patients presenting with respiratory symptoms, fever, and coughing up blood should raise one’s suspicion.

Precautions include droplet isolation until plague pneumonia is excluded in suspected cases. Isolation is recommended for patients for 72 hours while on antibiotics. Standard precautions are appropriate for bubonic plague. Given that *Yersinia pestis* is susceptible to sunlight, heat, disinfectants, and soap and water, decontamination is relatively easy.\(^6\)

**Botulinum Toxin**

*Clostridium botulinum* is an anaerobic, spore-forming bacterium found in soil. It produces a very potent neurotoxin (botulinum toxin) that is highly lethal if aerosolized (for instance, one gram of botulinum toxin could kill nearly 1.5 million people). Botulism is the clinical syndrome of
intoxication with botulinum toxin. Three types of naturally occurring human botulinum are
infantile/intestinal (germinating bacteria elaborates toxin in the gut), food-borne (pre-formed toxin
in food), and wound (rare, but spores infect a wound and release toxin). Deliberate release of
botulinum toxin would likely occur via aerosol or contamination of food or water supplies.
Incubation period ranges from 6 hours to 10 days, usually 1 to 3 days. Children may present with
profoundly weak muscle tone, weak cry, poor feeding, lethargy, irritability, eyelid lag, and with
flaccid, symmetrical, descending, motor paralysis that progresses to profound respiratory failure
requiring intubation and mechanical ventilation. Sensory nervous system remains intact, but level
of consciousness may deteriorate as respiratory failure ensues.

The mainstay of therapy is supportive care, i.e., endotracheal intubation, mechanical ventilation.
Standard precautions should be instituted. Secondary spread from patient to healthcare worker is
unlikely. The toxin is sensitive to heat, sunlight, chlorine and soap and water. Treatment with
human-derived antitoxin is available for treatment of infant botulism.

**Tularemia**

*Francisella tularensis* is the causative agent. It is an aerobic, gram negative cocco-bacillus that
manifests when skin or mucous membranes contact the carcass or body fluids of an infected
animal. Other names are “rabbit fever” and “deer fly fever”.

There are seven clinical syndromes of tularemia, namely, pneumonic (pneumonia), typhoidal,
ulceroglandular (systemic symptoms with ulcerative lesion and lymphadenopathy), glandular
(lymphadenopathy and fever), oculoglandular (ocular symptoms with lymphadenopathy),
oropharyngeal (tonsillitis with lymphadenopathy), and septicemic (sepsis, plus any of the above).
As a bioweapon, this cocco-bacillus will likely be released as an aerosol, and the clinical syndrome
of typhoidal tularemia with pneumonia will predominate. The incubation period is about 3 to 5
days, but may range from 1 to 21 days. Signs and symptoms include an influenza-like febrile
illness with vomiting, diarrhea, headaches, cough, and substernal or pleural chest pain with
difficulty breathing and occasional productive bloody cough. Prophylaxis for healthcare providers
may not be necessary, as there is no reported human-to-human transmission. If prophylaxis is
necessary, as in direct aerosol exposure, doxycycline is recommended. Observation of standard
precautions will suffice. Disinfectants or heat easily neutralizes the organism.

**Viral Agents**

**Smallpox (Variola Major)**

Smallpox is a virus whose incubation period is about two weeks, but ranges from 7 to 17 days.
Infection occurs via respiratory droplet and is highly contagious. Should a single case occur, it
would be an international public health emergency. Mortality is 30%. Clinical manifestations
include a prodromal phase of high fever, malaise, prostration, headache, and backache followed by
maculopapular rash on face, mouth, forearms, legs and trunk. Within 1-2 days, the rash evolves
from papular to vesicular to pustular (round, tense and deep pus), with coalescence to crust
formation approximately one week later. The lesions then separate and scab over. Although to the
untrained eye smallpox lesions may confused with chickenpox (varicella), it is distinguished by the
fact that smallpox rash progresses through different stages at the same rate and tends to concentrate
on the face, extremities, palms and soles (centrifugal, or “center-fleeing”, distribution). In contrast,
chickenpox lesions progress in clusters (lesions at different stages), concentrate on the trunk, and typically spare palms and soles (centripetal, or “center-seeking”, distribution). Diagnosis is made clinically based on appearance of rash and symptoms. Confirmation of clinical diagnosis requires sophisticated lab testing of the highly infectious vesicle fluid.

Smallpox is transmitted via contact with respiratory droplets, lesions, bedding or clothing. Treatment is mainly supportive care. Isolation is recommended. Respiratory and contact precautions should be instituted. Patients should be placed in negative pressure rooms and quarantined till lesions are crusted over. Although it would be ideal for close contacts to be quarantined for two weeks, it is not practical. Some authors have recommended a more pragmatic approach of having close contacts of confirmed smallpox cases check their temperatures daily, and if febrile (38°C) during the two week period of close contact, they should be quarantined at home until lesions crust over or smallpox is ruled out.

Smallpox vaccination may prevent or, at least, attenuate major disease, if administered within 72 hours of smallpox exposure and may also provide up to five years protection, at minimum. Smallpox vaccine has been associated with high rates of severe adverse reactions (encephalitis, disseminated vaccinia, and death). There are no current approved antivirals.

**Viral Hemorrhagic Fevers (VHF)**

VHF are caused by a family of RNA viruses and are transmitted to humans from animal reservoirs or arthropod vectors. They comprise a diverse group of highly contagious illnesses that cause high morbidity and mortality, and include Ebola, Marburg, Lassa fever, Venezuelan fever, hantavirus, yellow fever, and Dengue fever. The incubation period is usually 5-10 days (range, 2-19 days). The overall mortality is 20%, but may approach 100% for particular strains of these viruses. Signs and symptoms range widely and include abrupt onset of fever, body aches, conjunctivitis, facial flushing, prostration, petechiae, mucosal bleeding, vomiting, diarrhea, jaundice, hemorrhage, shock and renal failure. The clinical picture is most helpful in diagnosis. Stool and nasal swabs may be sent for viral culture. Sophisticated lab centers can test serum for the virus.

The mainstay of treatment is supportive care. Gentle fluid resuscitation with intravenous fluids and intensive supportive care with invasive monitoring should be performed, as the ongoing pulmonary capillary leak and bleeding disorder could worsen pulmonary edema and blood loss. Respiratory and contact precautions with gloves, gown, mask and use of N-95 mask with eye protection will reduce transmission. N-95 or higher respirators should be used for aerosol-generating procedures (e.g., endotracheal intubation). Patients should be placed in respiratory isolation. Decontamination is achieved with hypochlorite disinfectants.

**Other Infections (Non-bioterrorism)**

**Avian Influenza/Pandemic Influenza**

**Identification of illness**

The term “epidemic” is classically used to describe outbreaks of an infectious disease widespread among a populations within, yet typically confined to, a specific geographic area. By contrast, the term “pandemic” describes an infectious disease that more or less simultaneously afflicts large populations in numerous geographic areas within a given region. In previous eras, epidemics might be limited to individual population centers, i.e., cities. However, in the modern era, air travel has the potential to convert local epidemics into worldwide pandemics in days to weeks.
Avian influenza A virus usually does not infect humans, but since 2003 more than 330 cases of human infection due to the avian H5N1 influenza A virus have been reported, none of which have as yet occurred in the U.S. Most cases were transmitted to humans from sick or dead poultry that lived with or in close proximity to the infected humans. Ongoing spread in bird populations and outbreaks of human illness are monitored worldwide. The clinical manifestations range from conjunctivitis to influenza-like symptoms (fever, cough, sore throat, myalgias) to severe respiratory illness. During the pandemic alert, the main epidemiologic exposure risks for human-to-human transmission are international travel (e.g., visits to geographic areas affected by highly pathogenic avian influenza A) and occupational exposure (e.g., handlers of infected poultry).

With ongoing genetic changes within strains of avian influenza viruses, there is the potential for easier transmission between humans. It is at this point that an influenza pandemic might occur. Currently the following criteria are suggested for identifying cases: Any suspected cases of human infection with a novel influenza virus must first meet the criteria for influenza-like illness (ILI), defined as temperature of >38°C plus either sore throat or cough. Dyspnea should be considered as an additional criterion. Therefore, the full clinical criteria are fever plus one of the following: sore throat, cough, or dyspnea. However, in young children, the presentation may be more nonspecific (sepsis-like picture), and might include additional symptoms such as diarrhea or neurologic complications.

While cases of pandemic avian influenza have previously resulted in severe respiratory illness, the next pandemic influenza virus may present with a different clinical syndrome. Updates of the clinical criteria will be provided by the CDC at www.cdc.gov/flu.

The incubation period for seasonal influenza is 1-4 days, but may be different for pandemic influenza, perhaps as long as 10 days. Precautions for symptomatic children during the pandemic period will most likely be similar to influenza (droplet precautions), but may initially include airborne and contact precautions. Definitive guidance will be provided following initial epidemiologic investigations. The CDC gives detailed interim information on the use of face masks and respirators during an influenza pandemic [see resource section below]. Antiviral prophylaxis may be available. Development of a vaccine active against the next pandemic influenza strain will be a high priority, but a vaccine may not be available early during a pandemic.

**Infections Encountered After Natural disasters**

Several recent disasters have demonstrated the increased occurrence of infectious diseases related to changes in the environmental conditions such as lack of clean water, poor sanitary conditions and crowding, and lack of access to medical care. During the first few days following a disaster, one can expect injury and soft tissue infections, while gastroenteritis can occur up to 1 month after a disaster.1 Outbreaks of common pathogens which spread easily should be expected (e.g. norovirus).2 An additional concern is spread of multi-drug resistant bacteria, such as methicillin-resistant staphylococcus aureus (MRSA).3

In addition to standard precautions, contact precautions may be indicated when pathogens can be transmitted by contact such as bacteria and viruses causing gastroenteritis or certain multi-drug resistant bacteria. Alcohol-based hand hygiene products may be ineffective against norovirus. Hand hygiene with soap and water is preferred for patients with diarrhea.
Other Medical Considerations

Respiratory problems may be exacerbated or triggered by wildfires, fires involving trash and debris, or mold growing in damp buildings. Children with chronic or recurrent medical problems, such as diabetes or asthma, may find that their conditions worsen due to stress and environmental changes. Furthermore, post disaster conditions may make it difficult for families to seek medical assistance for their children as promptly as they would under ordinary circumstances. Compliance with medical instructions and follow-up care may be difficult as well. Therefore, children who would normally be treated by a family physician may need to visit the emergency department or urgent care center for necessary care, provided the hospital itself remains functional in the aftermath of the disaster.

Widespread power outages can cause additional problems for children who require refrigerated medications, such as those with diabetes. Children with special health care needs who depend on electronic support devices may also be affected after emergency supplies and batteries give out (discussed separately in chapter on special needs).
Table 1. Primary Biological Agents

<table>
<thead>
<tr>
<th>Disease</th>
<th>Etiology</th>
<th>Clinical Findings&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Incubation Period</th>
<th>Diagnostic Samples</th>
<th>Diagnostic Tests</th>
<th>Isolation Precautions</th>
<th>Initial Treatment&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax</td>
<td>Bacillus <em>anthracis</em></td>
<td>Inhalational: febrile prodrome with rapid progression to mediastinal lymphadenitis, mediastinitis (chest xray: +/- infiltrates, widened mediastinum, pleural effusions); sepsis; shock; meningitis. Cutaneous: papule progressing to vesicle, to ulcer, then to depressed black eschar, with marked edema</td>
<td>1-5 days (up to 6 wks ?)</td>
<td>Blood CSF Pleural fluid</td>
<td>Culture Gram stain ELISA PCR</td>
<td>Standard</td>
<td>Ciprofloxacin: 10-15 mg/kg (max 400 mg) IV q 12 h , or Doxycycline: 2.2mg/kg ( max 100mg) IV q 12h&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Ciprofloxacin: 10-15 mg/kg (max 500 mg) PO q12h X 60 days, or Doxycycline: 2.5 mg/kg (max 100 mg) PO q12h X 60 days&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Plague</td>
<td><em>Yersinia pestis</em></td>
<td>Febrile prodrome with rapid progression to fulminant pneumonia with bloody sputum, sepsis, DIC</td>
<td>2-3 days</td>
<td>Blood Sputum Lymph node aspirate</td>
<td>Culture Gram or Wright-Giemsa stain ELISA, IFA Ag-ELISA</td>
<td>Pneumonic: droplet until patient treated for 3 days</td>
<td>Gentamicin: 2.5 mg/kg IV q 8h&lt;sup&gt;4&lt;/sup&gt; or Doxycycline: 2.2 mg/kg IV ( max 100 mg) IV q 12h, or Ciprofloxacin 15 mg/kg ( max 500mg) IV q12h, or Chloramphenicol 25mg/kg (max 1 g) q 6h</td>
<td>Doxycycline 2.2 mg/kg (max 100 mg) PO q12h X 7d, or Ciprofloxacin 20 mg/kg ( max 500 mg) PO q12h X 7d, or Chloramphenicol 25 mg/kg (max 1 g) PO q6h X 7 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disease</th>
<th>Etiology</th>
<th>Clinical Findings¹</th>
<th>Incubation Period</th>
<th>Diagnostic Samples</th>
<th>Diagnostic Tests</th>
<th>Isolation Precautions</th>
<th>Initial Treatment²</th>
<th>Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallpox</td>
<td>Variola virus</td>
<td>Febrile prodrome</td>
<td>7-17 days</td>
<td>Pharyngeal swab</td>
<td>ELISA, PCR</td>
<td>Airborne, droplet, contact</td>
<td>Supportive care</td>
<td>Vaccination within 4 days (consider Vaccinia immunoglobulin: 0.6 mL/kg IM within 3 days of exposure for vaccine complications, immunocompromised persons)</td>
</tr>
<tr>
<td>Tularemia</td>
<td>Francisella tularensis</td>
<td>Pneumonic: abrupt onset fever, fulminant pneumonia (chest xray: prominent hilar adenopathy) Typhoidal: fever, malaise, abdominal pain</td>
<td>2-10 days</td>
<td>Blood, sputum, Serum</td>
<td>Culture³ Serology: agglutination</td>
<td>Standard</td>
<td>Gentamicin 2.5 mg/kg IV q8h ³, or Doxycycline 2.2 mg/kg (max 100 mg) IV q12h, or Ciprofloxacin 15 mg/kg (max 500 mg) IV q12h, or Chloramphenicol 15 mg/kg (max 1 g) IV q6h</td>
<td>Doxycycline 2.2 mg/kg (max 100 mg) PO q12h, or Ciprofloxacin 15 mg/kg (max 500 mg) PO q12h</td>
</tr>
<tr>
<td>Botulism</td>
<td>Clostridium botulinum</td>
<td>Afebrile Descending flaccid paralysis Cranial nerve palsies Sensation and mentation intact</td>
<td>1-5 days</td>
<td>Nasal swab</td>
<td>Mouse bioassay, Ag-ELISA</td>
<td>Standard</td>
<td>CDC trivalent antitoxin (serotypes A, B, E), 1 vial (10 mL) IV DOD heptavalent antitoxin (serotypes A-G) (IND) California Dept of Health immunoglobulin (IND)</td>
<td>None</td>
</tr>
<tr>
<td>Viral hemorrhagic fevers</td>
<td>Arenaviridae (e.g. Lassa fever) Filoviridae (Ebola, Marburg)</td>
<td>Febrile prodrome; rapid progression to shock, purpura, bleeding diathesis</td>
<td>4-21 days</td>
<td>Serum, blood</td>
<td>Viral isolation Ag-ELISA RT-PCR Serology:Ab-ELISA</td>
<td>Contact, droplet; consider airborne if massive hemorrhage</td>
<td>Supportive care</td>
<td>Ribavirin (arenaviruses) 30mg/kg IV initially 15 mg/kg IV q6h X 4 days 7.5 mg/kg IV q8h X 6 days</td>
</tr>
</tbody>
</table>

¹Syndrome expected after aerosol exposure. ²CDC recommended one or two additional antibiotics for inhalational anthrax in Fall, 2001 outbreak: rifampin, vancomycin, penicillin or ampicillin, clindamycin, imipenem, or clarithromycin. Recommendations in future outbreaks may evolve rapidly, and frequent consultation with local health departments and CDC (1-770-488-7100; www.bt.cdc.gov) is encouraged. ³Amoxicillin 80 mg/kg/day divided q8h can be substituted if strain proves susceptible. ⁴Streptomycin 15 mg/kg IM q12h may be substituted if available. ⁵Laboratory must be notified that tularemia is suspected.
**Tables / Figures**

Table 1 - overview

Fact Sheets

- Anthrax [http://emergency.cdc.gov/agent/anthrax/basics/factsheets.asp](http://emergency.cdc.gov/agent/anthrax/basics/factsheets.asp)
- Plague [http://www.cdc.gov/ncidod/dvbid/plague/info.htm](http://www.cdc.gov/ncidod/dvbid/plague/info.htm)
- Tularemia [http://jama.ama-assn.org/cgi/content/full/285/21/2763](http://jama.ama-assn.org/cgi/content/full/285/21/2763)

**Web-based Material**

CDC - general and specific information on bioterrorism:

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

U.S. Army Medical Research Institute of Infectious Diseases:


CDC - smallpox tools:


CDC - viral hemorrhagic fevers manual:

- [http://www.cdc.gov/ncidod/dvrd/spb/mnpages/vhfmanual.htm](http://www.cdc.gov/ncidod/dvrd/spb/mnpages/vhfmanual.htm)

CDC - What You Should Know about Using Facemasks and Respirators during a Flu Pandemic:

- [http://www.cdc.gov/Features/MasksRespirators/](http://www.cdc.gov/Features/MasksRespirators/)

PandemicFlu.gov - Emergency Medical Services and Non-Emergent (Medical) Transport Organizations Pandemic Influenza Planning Checklist:


The Association for Infection Control Practitioners – guidelines for infection control and precautions:

- [http://www.apic.org](http://www.apic.org)
References


Chapter 15: Prehospital and EMS Systems Care for Children with Special Health Care Needs in Disasters

Michael Tunik MD

Introduction

There are approximately 80 million children in the USA. 12 million have special health care needs. Prehospital providers will likely encounter children with special health care needs (CSHCN), given advances in medical care and improvements in technology allowing these children to be supported in a home setting.

Problems caused by a disaster, including access to shelter, food, water and supervision, are only the beginning for children with special health care needs. They are also dependent on medications, specialized equipment (which frequently requires a source of electricity to operate), and the knowledge and skill of their family or health professional caregivers to keep them alive.

Given the increased vulnerability of CSHCN, and the problems identified in organizing and providing care for vulnerable populations in recent disasters (eg. hurricane Katrina), only preparation at all levels will mitigate or prevent CSHCN from becoming unstable, or dying from the chaos of a disaster situation.

Definition of CSHCN (Children with special health care needs)

The following definition of CSHCN was developed by an EMSC task force in 1997.

“Those who have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally.”

This broad definition includes approximately 15 children in the USA. Clearly this large number of CSHCN creates a great challenge in disaster preparation and care during an event.

Overview of CSHCN and TAC (Technologically Assisted Children)

Children with special health care needs encompass a broad spectrum of disease entities. These can be classified as problems in the following areas: airway, pulmonary, cardiovascular, neurologic, hematology/oncology, immunology, endocrine, genetic birth defects, traumatically induced problems, and musculoskeletal injuries (adapted from SCOPE program).

Medical Conditions

- Airway Pulmonary
- Asthma
- Bronchopulmonary Dysplasia (BPD)
- Cystic Fibrosis
- Tracheomalacia
- Tracheal Stenosis
- Tracheal Atresia
- Babies with Apparent Life Threatening Event
- Apnea

**Cardiac**
- Complex Congenital Cardiac Defects
- Acyanotic Defects
- Cyanotic Defects

**Down Syndrome other congenital birth problems**

**Traumatically Disabled Children**

**Neurological Problems**
- Epilepsy
- Hydrocephalus
- Mental Retardation
- Spina Bifida
- Cerebral Palsy

**Hematology/Oncology**
- Sickle Cell Disease
- Cancer

**Immunologic**
- HIV and AIDS

**Endocrine**

**Musculoskeletal**
- Children who have had meningitis
- Birth Defects
- Genetic Disorders
- Osteogenesis Imperfecta (OI or "Brittle Bone Disease")

Children with these health problems have unique health care needs that may include medications and supportive health care equipment. Examples include: a child with diabetes who is dependant
on insulin, insulin syringes, and blood sugar monitoring devices; a child who has a tracheostomy, who is dependent on a home ventilator. Examples of specialized medical technology for CSHCN follow.3,4

**Technology needed to support CSHCN**

- Tracheostomy and Tracheostomy tubes
- Home ventilators
- Bi Level Positive Airway Pressure (BiPAP)
- Central IV Catheters
- Internal Pacemakers Defibrillators
- Feeding Catheters / Gastrostomy Tubes
- Colostomies
- CSF Shunts (Cerebral Spinal Fluid Shunts)
- Vagal Nerve Stimulators

- Children with special health care needs have unique health care challenges on a day-to-day basis. They are more dependent on their parents, home health care professional staff, teachers and school nurses, and their physician providers of ongoing medical care than other children.

**Role of Family Members and the Importance of Avoiding Caregiver Child Separation**

- CSHCN should not be separated from family members, as this places their lives at risk. The families of CSHCN play a critical role in the ongoing assessment and care of their children. They are familiar with what is normal for their children, and are able to provide for their typical health care needs. In a disaster, separation of these children from their regular caregivers creates a high risk for a stable child with special health care needs to become unstable, simply due to this separation.

**Education of Prehospital Providers in Caring for CSHCN**

Prehospital providers (PHP) will encounter children with special health care needs as the numbers of these children at home or in school increase. To educate PHP to be able to recognize and care for many of the medical problems these children have, and to understand the function of the special medical devices that support their vital functions is beyond the scope of this chapter. There are excellent educational resources, originally developed through EMSC grants, available to educate PHP is some of the more common medical problems and technologies. These include the SCOPE program (Special Children's Outreach and Prehospital Education) available through the EMSC NRC and NEDARC websites⁵, and student manual published by Jones and Bartlett⁶, as well as chapters in the EMT and Paramedic TRIPP (Teaching Resource for Prehospital Providers), created by CPEM⁷. These educational courses and resources are a good starting point, but are insufficient to cover all the possible medical problems from which CSHCN may suffer.
Emergency Information Form

The AAP and ACEP have developed an Emergency Information Form (EIF). This form should be completed by the child’s physician, and family members / caregivers. The EIF contains a summary of the child’s and parents’ primary language, diagnoses, normal vital signs, appearance and behaviors for CSHCN. It also contains information on current medications, dosing, allergies, as well as settings for special medical equipment (eg. Ventilator settings). Other information includes contact information for the child’s family members, and physician(s). This form should be completed and copies available with the child at all times, in the school, physicians office, day care and other places the child spends time. EMS for Children grant demonstration projects have created a secure web site to allow access to the CSHCN EIF from any web enable location. This has demonstrated the viability of accessing this critical information via the internet. EMS agencies can provide a valuable service, by identifying CSHCN in their region, insuring these children have an EIF form completed, and targeting these children and families with focused resources during a disaster.

Emergency Preparedness Checklist for families of CSHCN

Disasters create situations that place normal, healthy children and adults at great risk. Preparation and planning for the eventuality of a disaster is recommended for all individuals. These recommended preparations have been widely disseminated and include decisions to shelter in place or to evacuate from the home. In case of evacuation, preparation should include a go pack, which contains necessities such as water, light source, radio, important documents, and medications for several days. CSHCN have increased needs and therefore require increased planning and preparation. Public health agencies, and EMS agencies may provide families of CSHCN with disaster evacuation plans. One example of a disaster plan checklist for CSHCN can be found below, and is available on the EMSC NRC website. Another example can be found on the web in English and Spanish (Emergency and Disaster Planning for CSHCN Department of State Health Services, Texas).

Disaster Preparedness Checklist for CSHCN

- Develop a plan that describes your child’s daily care routines.
- Complete an emergency information form or health care summary that includes the names and contact information for your child’s primary health care provider and specialists.
- Have on hand a 2-week supply of medications (prescription and non-prescription).
- Store a 2-week supply of equipment and supplies (such as tracheotomy tubes, nasal cannulas, suction catheters, diapers, dressing materials, feeding tube bags and tubing, etc.).
- Store a 2-week supply of food, including foods for special diets.
- Purchase battery back-up or a generator for any equipment that requires electricity.
- Identify a pre-planned location to shelter your child during a disaster.
- Store extra supplies to help care for your child should a disaster occur while he/she is at school or with a childcare provider.
• Notify neighbors and emergency medical services providers that you have a child with special health care needs and may need additional assistance during a disaster.

**National, Regional and Local planning to support CSHCN**

Children with special health care needs require special focus and efforts at many levels before and during a disaster to ensure their unique needs will be met. They are clearly more vulnerable, and have a greater need for specialized attention including: medications, equipment, electricity to charge and run special equipment, and expert medical care (provided by family, physicians and hospitals). This planning and preparation must not only occur within the family, and medical home, but at community, regional, state and federal levels to be effective.

• A national consensus conference, held in 2003, focused on the needs of children during disasters, and made recommendations for CSHCN.12

**Recommendations for CSHCN from a National Consensus Conference**

• Incorporate considerations for CSHCN in all disaster and terrorism planning at the national, state, and regional/local levels (eg, water, dialysis, medication).

• Identify all CSHCN to ensure each child has a medical home, adequate medical coverage, and support mechanisms before a disaster or terrorist event.

• Ensure that all CSHCN are considered in emergency preparedness plans of the Department of Homeland Security.

• Develop mechanisms for identification of and community planning for children with increased vulnerability in disasters, including CHSCN and their families, at the national, state, and regional/local levels.

• Provide federal, state, and local government funding for emergency preparedness planning and implementation of services to meet the needs of CSHCN. This funding must be timely, immediately accessible, and of sufficient duration.

• Explore, within government agencies, development of non-traditional, community-based support systems for CSHCN and their families (eg, independent living centers, faith-based groups, parent-based groups).

• Mandate continuity of operations and mutual aid planning among community health facilities to address disaster and terrorist events for pediatric populations, including CSHCN

• Unfortunately the vast majority of the recommendations from this national consensus conference have gone unheeded. The consequences of not following recommendations from this consensus conference for CSHCN needs have been tragic. Children with special health care needs suffered unnecessarily during and after hurricane Katrina struck the gulf coast. Children who required electricity to power portable ventilators and asthma nebulizers suffered due to lack of access to a power source. Some CSHCN were evacuated in family vehicles, due to a lack of other evacuation methods. Besides no power for medical devices, some of these children ran out of medication.

• This is not the only disaster in which lack of electrical power has caused individuals with special health care needs to suffer. The failure of the US eastern seaboard electrical power grid
in August 200, created an unplanned increased demand for EMS runs. The majority were due to respiratory device failure (mechanical ventilators, positive pressure breathing assist devices, nebulizers, and oxygen compressors). The failure of the equipment was due to need for electricity to power these medical devices.13

Problems Identified in the Wake of Hurricane Katrina2

Inadequate Disaster Planning at the Federal, State and Local Government Levels created a lack of support and planning for:

- Care and evacuation of hospitalized children, infants, and premature newborns
- Structurally intact hospitals and other care facilities not supplied with adequate power, water, food, supplies, and security
- Evacuation of children with their parents, families, or caretakers
- Reunification of children with their parents/caretakers (especially infants and preverbal toddlers)
- Culturally and developmentally appropriate critical incident mental health interventions
- Increased risk of morbidity and mortality for CSHCN during and after the disaster

Only pre planning and focused action before and during a disaster can prevent CSHCN from suffering worsening illness or death due to lack of critical medical resources. The pre planning needs to occur at all levels to be effective. The levels of care that require special preparation for these children include:

- Family
- Physician / Medical Home
- Community
- EMS system
- Shelter care
- Hospital Local and Regional Medical Care

Recommendations for Disaster Planning for CSHCN

Families of CSHCN

- Complete a Disaster Preparedness Checklist
- Stock sufficient medications and equipment for 2 weeks of care
- Complete EIF, keep 1 with the child, provide 1 to regional EMS agency
- Inform the regional EMS agency of the presence of a child with special needs
- Identify specialized local / regional medical care in case of a disaster
- Identify numbers to call for help with medical care, evacuation of CSHCN
EMS Providers
- Train Prehospital providers to care for common emergencies in CSHCN
- Request the CSHCN patients EIF
- Locate Special Equipment, or Medications for CSHCN (Go Pack, Hospital)
- Use specialized triage and transport methods to transport CSHCN to appropriate Hospitals or Shelters equipped to handle CSHCN / TAC

EMS Agencies
- Work with local hospitals and community groups
- Identify CSHCN, request EIF forms for these children
- Assist families in locating and completing the EIF forms
- Identify local / regional shelters that have special provisions for CSHCN
- Identify local / regional hospitals that have special provisions for CSHCN
- Incorporate specialized triage for CSHCN to shelters / hospitals
- Provide for specialized transport for CSHCN

Federal, State and Regional Disaster and EMS Systems
- Incorporate considerations for CSHCN in all disaster planning
  - Develop triage plans for all CSHCN
  - Develop transport arrangements for CSHCN
  - Prepare special shelters for CSHCN
  - Prepare extra hospital / medical resources for CSHCN
  - Include access to electricity for wheelchairs, ventilators other special equipment
- Identify all CSHCN
- Ensure each CSHCN has
  - a medical home
  - adequate medical coverage
  - support mechanisms before a disaster or terrorist event
- Prepare for regional evacuation of CSHCN including those in hospital settings, when regional disasters (eg. Hurricane Katrina) cause the closure of local hospitals

References


11. Emergency and Disaster Planning for CSHCN (Checklist) Texas Department of State Health Services http://www.dshs.state.tx.us/CSHCN/pdf/emer_plan.pdf accessed 6/12/08


Equipment for Care of Pediatric Patients in the Prehospital Setting during Disasters

Equipment for care of children in the prehospital setting during disasters includes basic life support and advanced life support ambulance equipment. National recommendations for BLS and ALS ambulance equipment have been available for more than 10 years. The Committee on Ambulance Equipment and Supplies of the National EMSC Resource Alliance was convened to develop a list of essential and recommended pediatric equipment that should be carried on all ambulances providing basic and advanced life support services. The committee included representatives from the following organizations:

- American Academy of Pediatrics
- American Ambulance Association
- American College of Emergency Physicians
- American College of Surgeons
- Bureau of Maternal and Child Health (Health Resources and Services Administration, US Department of Health and Human Services)
- Emergency Nurses Association
- International Association of Fire Chiefs
- International Association of Fire Fighters
- National Association of State EMS Organizations
- National Association of EMS Physicians
- National Association of EMTs and Paramedics
- National Association of State Medical Directors
- National EMSC Resource Alliance
- National Highway Traffic Safety Administration

The group’s consensus report was published in Pediatric Emergency Care (Guidelines for pediatric equipment and supplies for basic and advanced life support ambulances. 1996;12(6):452–453).

The best way to prepare for children during disasters is to start by preparing for children’s’ emergency care needs. Therefore the recommended ambulance equipment listed that follows should be part of all EMS systems ambulance equipment.

There are many circumstances in which additional equipment or medications are needed for children during disasters. Some examples, from other chapters in this resource include: pediatric dosing of atropine and 2 PAM in auto-injector kits used for nerve agent intoxications; special decontamination approaches for children - devices to keep infants secure on a stretcher during decontamination shower (plastic basket with openings to allow water drainage); special shelter needs (food, water, caregivers) for infants and young children.

Rather than repeat these additional equipment, supplies and medications here, we recommend that they be located in their specific chapters.
## BASIC LIFE SUPPORT AMBULANCE EQUIPMENT

### Essential

<table>
<thead>
<tr>
<th>Stethoscope, BP measurement</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Stethoscope</td>
<td></td>
</tr>
<tr>
<td>BP cuffs (infant, child, and adult)</td>
<td></td>
</tr>
<tr>
<td>Length-based resuscitation tape or drug/dose chart</td>
<td></td>
</tr>
</tbody>
</table>

**Oxygen, Suction, And Ventilation:**

<table>
<thead>
<tr>
<th>Oxygen Tank</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Regulator</td>
<td></td>
</tr>
<tr>
<td>Oropharyngeal airways: infant, child, and adult (size 00 – 5)</td>
<td></td>
</tr>
<tr>
<td>Simple face masks (infant, child, and adult sizes)</td>
<td></td>
</tr>
<tr>
<td>Non-Rebreather masks (child, and adult sizes)</td>
<td></td>
</tr>
<tr>
<td>Nebulizer (with mask or “T-piece”) *</td>
<td></td>
</tr>
<tr>
<td>Bag valve device - self inflating (sized for neonates, infants, and children) **</td>
<td></td>
</tr>
<tr>
<td>Masks for bag valve device (sized for neonates, infants, children, and adults)</td>
<td></td>
</tr>
<tr>
<td>Portable suction unit with a regulator</td>
<td></td>
</tr>
<tr>
<td>Suction catheters (sizes 6F – 14F) and tonsil-tip</td>
<td></td>
</tr>
<tr>
<td>Bulb syringe</td>
<td></td>
</tr>
</tbody>
</table>

**Monitors / Defibrillator:**

| Automatic External Defibrillator with pediatric & adult pads*** |  |
| Pulse oximeter **** |  |
### Immobilization:

- Cervical immobilization collar (infant, child, adolescent & adult)
- Backboard
- Padding (blankets, towels, etc.)
- Straps/cravats
- KED/short board
- Extremity splints (include pediatric sizes)

### Additional Equipment:

- Obstetric pack
- Thermal blanket +
- Water-soluble lubricant
## Desirable

### Desirable Equipment Set:

<table>
<thead>
<tr>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant car seat</td>
</tr>
<tr>
<td>Nasopharyngeal airways (18F – 34F, or 4.5-8.5 mm) ++</td>
</tr>
<tr>
<td>Glasgow Coma Scale reference</td>
</tr>
<tr>
<td>Pediatric Trauma Score reference</td>
</tr>
<tr>
<td>Small stuffed toy</td>
</tr>
<tr>
<td>Electronic Thermometer (ear, forehead, rectal, armpit, oral)</td>
</tr>
<tr>
<td>Length Based Resuscitation Tape</td>
</tr>
<tr>
<td>Nasogastric and Orogastric tubes</td>
</tr>
<tr>
<td>20 mL syringe</td>
</tr>
<tr>
<td>Computer with CD-ROM (at base station)</td>
</tr>
<tr>
<td>EMS for Children training disks (at base station)</td>
</tr>
</tbody>
</table>

*The use of nebulized medications is based on regional protocols

**The ventilation bag should be self-inflating, with an oxygen reservoir and no pop-off valve. The bag for a child has a reservoir of 450 mL; an adult bag has a reservoir of at least 1000 mL.

***The list was developed prior to the common use of Automatic External Defibrillators, which are recommended by the AAP and carried by many BLS providers at an EMT-D level of training.

**** Pulse oximetry came into use after this article was published. If available, it can be a valuable adjunct in determining the severity of respiratory compromise in children.

+A thermal blanket may help minimize heat loss, reducing the severity of hypothermia, a potentially serious complication, particularly in infants and young children. Its composition depends on local availability, regional protocols, and procedures. Possibilities include Mylar, standard cotton or acrylic, or aluminum foil for young infants.

++If an oropharyngeal airway cannot or should not be used in a patient with respiratory compromise due to upper airway obstruction, a nasopharyngeal airway may be substituted. Providers must be trained in proper insertion techniques as well as indications and contraindications for the device.
## ADVANCED LIFE SUPPORT AMBULANCE EQUIPMENT

<table>
<thead>
<tr>
<th><strong>Stethoscope, BP, and Length-based resuscitation tape:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stethoscope</td>
</tr>
<tr>
<td>BP cuffs (infant, child, and adult)</td>
</tr>
<tr>
<td>Length-based resuscitation tape or drug/dose chart</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Oxygen, Suction, And Ventilation:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen Tank</td>
</tr>
<tr>
<td>Regulator</td>
</tr>
<tr>
<td>Oropharyngeal airways: infant, child, and adult (size 00 – 5)</td>
</tr>
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</tr>
<tr>
<td>Bulb syringe</td>
</tr>
</tbody>
</table>
### Pediatric Advanced Airway:

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laryngoscope handle (adult and pediatric) with spare batteries, light bulbs</td>
</tr>
<tr>
<td>Pediatric laryngoscope blades: Straight (Miller): 0, 1, 2 and Curved (Macintosh): 2, 3, 4</td>
</tr>
<tr>
<td>Endotracheal tubes (sizes 2.5 – 6.0 uncuffed, 6.0 – 8.0 cuffed)</td>
</tr>
<tr>
<td>Stylettes for endotracheal tubes (2 sizes, 6F and 14F)</td>
</tr>
<tr>
<td>McGill forceps (pediatric and adult sizes)</td>
</tr>
<tr>
<td>Nasogastric / Orogastric tubes (8F – 16F)</td>
</tr>
<tr>
<td>Meconium aspirator</td>
</tr>
<tr>
<td>End-tidal CO₂ detector</td>
</tr>
<tr>
<td>Eye protection</td>
</tr>
</tbody>
</table>

### Monitors / Defibrillator:

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport monitor</td>
</tr>
<tr>
<td>Defibrillator with pediatric and adult paddles</td>
</tr>
<tr>
<td>Monitoring electrodes in pediatric and adult sizes</td>
</tr>
<tr>
<td>Conductive medium</td>
</tr>
<tr>
<td>Pulse oximeter</td>
</tr>
<tr>
<td>Appendix: Equipment</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td><strong>Vascular Access:</strong></td>
</tr>
<tr>
<td>IV catheters (16 - 24 gauge)</td>
</tr>
<tr>
<td>Intraosseous needles</td>
</tr>
<tr>
<td>Straight needles: sizes 20 to 25 gauge</td>
</tr>
<tr>
<td>Heparin or Saline lock</td>
</tr>
<tr>
<td>IV tubing</td>
</tr>
<tr>
<td>Venous Constricting Band</td>
</tr>
<tr>
<td>Alcohol swabs</td>
</tr>
<tr>
<td>Gloves</td>
</tr>
<tr>
<td>Arm boards in appropriate sizes</td>
</tr>
<tr>
<td>2&quot; × 2&quot; dry sterile gauze pads</td>
</tr>
<tr>
<td>Adhesive tape</td>
</tr>
<tr>
<td>Transparent, adhesive dressing</td>
</tr>
<tr>
<td>Povidone-iodine prep pads</td>
</tr>
<tr>
<td>1.0, 3.0, and 5.0mL syringes</td>
</tr>
<tr>
<td>Isotonic fluid (0.9NS or LR)</td>
</tr>
<tr>
<td>Resuscitation drugs and IV fluids (based on local regional protocols):</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>(Note: some drugs may fill more than one category, e.g. epinephrine)</td>
</tr>
</tbody>
</table>

| Resuscitation meds: |
| Epinephrine, atropine, lidocaine, sodium bicarbonate, amiodarone, dopamine, dobutamine, calcium chloride, magnesium sulfate, procainamide |

| Respiratory meds: |
| Albuterol, metaproterenol, terbutaline, ipratropium bromide, methylprednisolone |

| Antihistamine: |
| Diphenhydramine |

| Anticonvulsants: |
| Diazepam, lorazepam, midazolam |

| Pain/sedation: |
| Morphine sulfate, nitrous oxide, fentanyl, thiopental, ketamine, etomidate |

| Paralytics: |
| Succinylcholine, rocuronium, vecuronium, pancuronium |

| Poisoning/OD: |
| Activated Charcoal, naloxone, flumazenil |

| Endocrine: |
| Glucose, Glucagon |

| Intravenous fluids: |
| Normal Saline, Ringers Lactate |
### Immobilization:
- Cervical immobilization collar (infant, child, adolescent & adult)
- Backboard
- Padding (blankets, towels, etc.)
- Straps/cravats
- KED/short board
- Extremity splints (include pediatric sizes)

### Additional Equipment:
- Obstetric pack
- Thermal blanket
- Water-soluble lubricant

### Desirable Equipment Set:
- Infant car seat
- Nasopharyngeal airway set (18F – 34F, or 4.5-8.5 mm)
- Glasgow Coma Scale reference
- Pediatric Trauma Score reference
- Small stuffed toy
- Blood glucose analysis system
- Umbilical vein catheter (5F) and umbilical tape
- Computer with CD-ROM (at base station)
- EMS for Children training disks (at base station)