



Rough and Ready

Disaster Preparedness for the Pediatric Population



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OBJECTIVES

On completion of this lesson, you should be able to:

1. Describe the principles of triage and, in particular, the triage of pediatric patients.
2. Explain what makes the pediatric population vulnerable in a mass casualty event.
3. Discuss the principles of decontamination and special decontamination considerations for children.
4. Detail the phases of disaster planning.
5. Discuss pediatric considerations in disaster planning.

FROM THE EM MODEL

- 20.0 Other Core Competencies of the Practice of Emergency Medicine
- 20.4 Systems-Based Practice

CRITICAL DECISIONS

- What considerations are most critical when evaluating a child injured in a mass casualty incident (MCI)?
- What triage methods are most reliable for assessing children?
- What factors make pediatric victims of an MCI especially vulnerable?
- How should the decontamination of pediatric patients be approached?
- How should the medical community prepare for pediatric victims of an MCI?

CASE PRESENTATIONS

■ CASE ONE

Bystanders call 911 after gunshots are heard during a high school basketball game. The two first responders arrive at the scene to find a crowd of people running from the gymnasium and five apparent victims.

The first victim is a 10-year-old girl, who is crying and holding her blood-streaked right leg. Her pulse is 120, respiratory rate 16, and she has palpable pulses in both feet. The second victim is a 5-year-old boy, lying face-down on the floor. He is not moving and has no palpable pulse or apparent respirations. Next to him is a teenage boy who is lying supine, gasping for air and moaning. He has blood on the front of his shirt, a pulse rate of 40, and a respiratory rate of 10; he is barely moving. At the other end of the gym are the other two victims — girls age 4 and 9 years. The younger child is screaming; blood is visible on the side of her head. Her pulse rate is 140 and respiratory rate is 28. The older girl is lying supine with agonal respirations; her pulse is barely palpable and she appears to have a gunshot wound to the face. The pair of first responders quickly assess the scene and start the triage process. Additional EMS units are still 20 minutes away.

■ CASE TWO

The pediatric emergency department is full-with multiple patients awaiting admission for a variety of seasonal ailments — influenza, bronchiolitis, asthma, and acute gastroenteritis. Soon there is breaking news about a highway accident involving more than 40 vehicles, including a school bus with multiple victims and “lots of kids.”

The clinician is told to expect at least 20 children, many with obvious injuries; at least 10 are “critical,” and two have had seizures. One of the trucks involved was a tanker carrying an unknown substance, and first responders are reporting an odd odor and similar complaints of an itchy throat, dry cough, nausea, wheezing, and shortness of breath. The first ambulance arrives with a rather quiet infant, a 6-year-old screaming for his mother, and an adult patient who is being bagged.

A mass casualty incident (MCI) is defined as any event that exceeds available resources because of overwhelming need from an unexpected number of patients. It can be particularly challenging to manage pediatric victims of such disasters, who may present with trauma, burns, or infections or be contaminated by neurologic, biologic, chemical, or radioactive agents.

Clinicians must be sensitive to the significant developmental, physiologic, and psychological differences of children, and understand the triage methods used to assess this vulnerable population. When faced with an MCI, hospitals that do not normally treat children may have to do so; conversely, pediatric hospitals may be forced to care for adult victims. It is imperative to have a well-organized plan in place well before disaster strikes.

In 2001, the American Academy of Pediatrics (AAP) and American College of Emergency Physicians (ACEP) issued joint guidelines on emergency preparedness for children, who account for more than 22% of all emergency department visits.^{1,2} Despite these national recommendations, concerns

remain about the current state of pediatric preparedness:

- Only 6% of emergency departments are equipped with all 118 recommended items for managing pediatric emergencies, particularly for neonates and infants.
- Fifty percent of emergency departments are unaware of the AAP/ACEP pediatric preparedness guidelines.³
- Less than 20% of EMS agencies use a pediatric-specific triage protocol, and less than 15% involve a pediatrician when implementing medical policies.
- Clinical skills deteriorate without continual and deliberate practice, and continuing education in pediatric prehospital care is limited.⁴
- Many medications and antidotes recommended for mass illnesses have not been validated for use in children.

CRITICAL DECISION

What considerations are most critical when evaluating a child injured in an MCI?

Triage is the first step in patient care during an MCI and the basis of successful and fair disaster medical management.

Decisions made at this point will greatly affect community and patient outcomes, both treated and untreated. The triage process should evolve as the event evolves — that is, change as resources or personnel are either outstripped or become available.

Daily triage identifies the sickest patients so that evaluation and treatment can be initiated early; the highest intensity of care is given to the most seriously ill patients despite their probability of survival.

Disaster triage, which focuses on transport and treatment priorities, is used when resources are limited and timely care cannot be provided. Its primary goal is to accomplish the greatest amount of good for the greatest number of patients.

A triage category should be assigned within 30 to 60 seconds. Victims with the best chance of survival should be identified so that immediate interventions can begin; care can be delayed in those at extremes of care (lightly injured and mortally injured). As resources and personnel often are quickly overwhelmed, disaster triage helps prioritize critically injured victims who are deemed salvageable.

CRITICAL DECISION

What triage methods are most reliable for assessing children?

While there is no universal, clinically validated system for pediatric triage, there are a variety of reliable MCI protocols.

START

The START (Simple Triage and Rapid Treatment) method is the most commonly used system of disaster triage in the United States. The first responders use an easily identifiable triage tag to categorize victims by severity of injury. The whole process should take 60 seconds or less.

Victims are assigned to one of four triage categories:

- **Minor (green)** — delayed care/can delay up to 3 hours;
- **Delayed (yellow)** — urgent care/can delay up to 1 hour;
- **Immediate (red)** — immediate care/life-threatening;
- **Deceased (black)** — victim is dead or mortally wounded/no care required.

START is a quick tool for assessing ambulation/ability to walk, airway, circulation, and neurologic function. Although the protocol can be used to address both pediatric and adult patients, there are substantial limitations to using the same system for both populations. Many children are unable or unwilling to walk or talk, especially when injured, ill, or frightened, limiting the tool's usefulness.

JumpSTART

The most widely used triage system for pediatric patients is the JumpSTART Pediatric Multiple Casualty Incident Triage (*Figure 1*) method.^{5,6} JumpSTART was developed in 1995 to address several pediatric issues that START does not; specifically age-dependent physiologic differences in respiratory rate, circulation, and mental status. It also addresses the nonambulatory status of infants and children. Standardizing the triage process of pediatric victims helps first responders use their heads rather than

their hearts by providing an objective framework.

The objectives of JumpSTART are to optimize the primary triage of injured children younger than 8 years, enhance the effectiveness of resource allocation for all MCI victims, and reduce the emotional burden on triage personnel forced to make rapid life-or-death decisions in chaotic circumstances.

The JumpSTART steps are as follows:

Airway (evaluated first)

- If not patent, reposition.
- If spontaneous respirations return, patient is tagged RED.
- If still apneic after repositioning, assess for a pulse.
- If no pulse, the patient is presumed dead and tagged BLACK.
- If there is a pulse, give 5 rescue breaths, “the JumpStart.”
- If spontaneous respirations return, the patient is tagged RED.
- If no change after five rescue breaths, the patient is tagged BLACK.

Respirations (acceptable rate is 15 to 45 breaths/minute)

- If respirations are below 15 or above 45, the patient is tagged RED.

Circulation (based on palpable pulse and not capillary refill)

- If there is no pulse, patient is tagged RED.
- If there is a pulse, assess level of consciousness.

Mental status (ability to follow commands is not reliable)

The AVPU scale is used (A=alert; V=responds to verbal stimuli; P=responds to painful stimuli; U=unresponsive).

- If ambulatory, patient is tagged GREEN.
- If alert or responding to verbal or painful stimuli, patient is tagged YELLOW.
- If unresponsive or inappropriately responsive to pain, patient is tagged RED.

SALT

The SALT triage method (sort, assess, lifesaving interventions, treatment, and transport) was created to simplify and standardize disaster triage for victims

of all ages; however, it is not pediatric-specific (*Figure 2*). It incorporates the most effective elements of existing triage tools while emphasizing continual reassessment.⁷

Lifesaving interventions, including controlling major hemorrhage, opening the airway, giving two rescue breaths for children, needle decompression for tension pneumothorax, and use of autoinjector antidotes, are implemented before a severity category is assigned. These should be completed prior to assigning a triage category, but only if supplies are readily available and the provider is trained in their use.

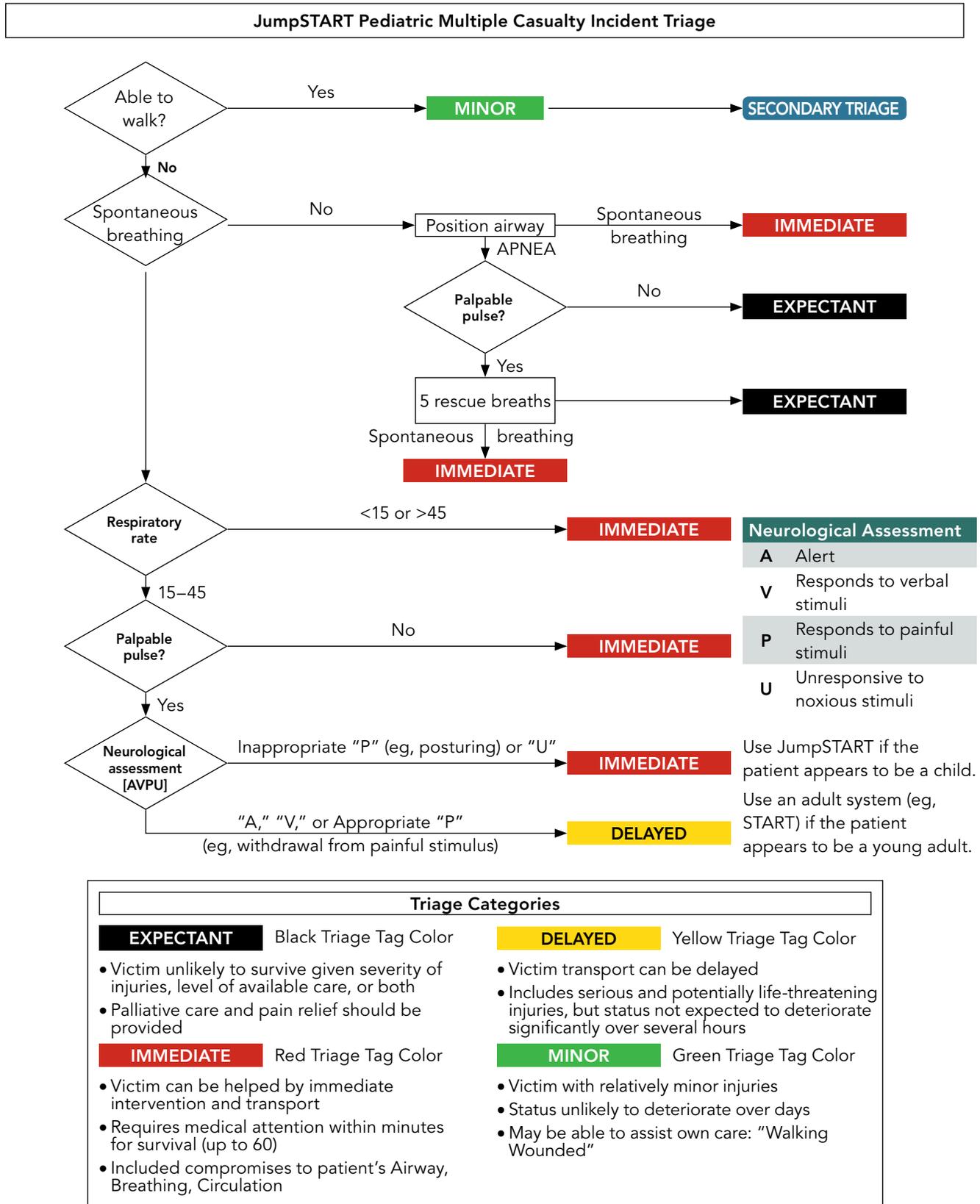
There are five levels of severity in the SALT triage method. In addition to the common categories seen in most tools (red, yellow, green, and black) SALT also includes a gray or “expectant” category. After lifesaving interventions have been performed, breathing is assessed. If not breathing, the patient is assigned to the “black” or “no further intervention” category.

If the patient is viable, an assessment is made of whether commands can be followed or there are purposeful movements, peripheral pulses, respiratory distress, and major hemorrhage. The categories assigned are:

1. **Minimal treatment (green):** minor injuries only;
2. **Delayed treatment (yellow):** may have some major injuries, but they are not life-threatening at present;
3. **Immediate treatment (red):** major injuries and likely to survive given current resources;
4. **Expectant treatment (gray):** major injuries but not likely to survive given current resources.

The gray classification allows providers to focus resources on potentially salvageable patients. As the situation evolves, priorities of care can shift depending on patient conditions, available resources, or scene safety issues.⁸

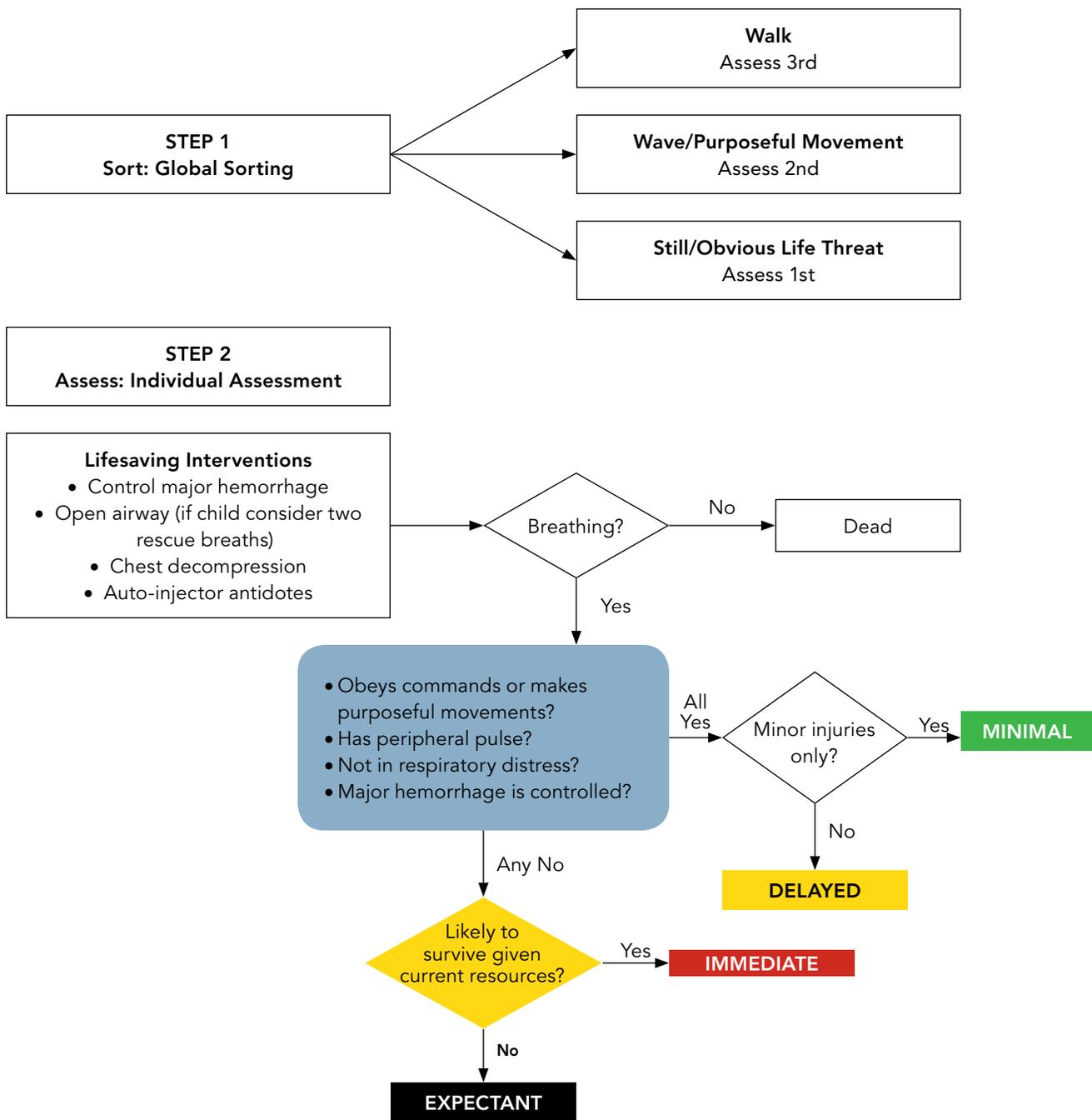
FIGURE 1. JUMPSTART PEDIATRIC TRIAGE ALGORITHM



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FIGURE 2. THE SALT TRIAGE METHOD

SALT Mass Casualty Triage Algorithm (Sort, Assess, Lifesaving Interventions, Treatment/Transport)



From: SALT mass casualty triage. Concept endorsed by the American College of Emergency Physicians, American College of Surgeons Committee on Trauma, American Trauma Society, National Association of EMS Physicians, National Disaster Life Support Education Consortium, and State and Territorial Injury Prevention Directors Association. *Disaster Med Public Health Prep.* 2008;2(4):245-246.

CRITICAL DECISION

What factors make pediatric victims of an MCI especially vulnerable?

Anatomy and Physiology

Children have smaller blood and fluid reserves, are more sensitive to changes in body temperature, and have higher metabolic rates, making deterioration rapid. Unexplained tachycardia often is the earliest and only sign of hemodynamic compromise in children. Hypotension usually occurs later and is a pre-arrest state in children, who have smaller circulating blood volumes than adults. Therefore, relatively small amounts of blood or fluid loss can lead to irreversible shock or death.

Children also have higher respiratory rates, making them more sensitive to aerosolized biological or chemical agents because they can inhale larger doses of a substance in the same period of time. They are also shorter, increasing their exposure to some agents that are heavier than air (eg, sarin and chlorine gas) and accumulate close to the ground. Children also have limited fluid reserves and become dehydrated faster, making them more vulnerable to the effects of agents that produce vomiting and/or diarrhea.

Their thinner, more permeable skin makes them particularly susceptible to burns or vesicants, and they absorb chemicals faster because of their larger body-surface-area-to-mass ratio. Because of their smaller size, relatively larger head and organs, and immature skeletal system, they are more likely to sustain serious head and multisystem organ injury from blunt trauma.

Psychology and Development

Children and infants may lack the self-preservation, cognitive, and motor skills required to flee from danger or follow directions from others to take shelter. Children are unlikely to possess the coping skills needed to deal with traumatic events and may be crippled by fear or anxiety during an MCI. There may be intensification of parent-child separation anxiety, especially if one or more parents have died. If at all possible, children should not be separated from their caregivers.

CRITICAL DECISION

How should the decontamination of pediatric patients be approached?

Infants and children requiring hospital-based decontamination prior to medical treatment have unique needs that require special consideration. Families should not be separated during the process unless medical issues take priority. Older children may be difficult to handle due to issues of fear, peer pressure, or modesty. Decontamination (“hot zone”) personnel may be needed to help families and unaccompanied children through the process. These personnel should be wearing personal protective equipment (Table 1), which can make decontamination even more frightening for children (Figure 3).⁹

To ensure safety, the decontamination showers should have “child-friendly” high-volume, low-pressure water delivery systems (eg, handheld hose sprayers). Mild detergents instead of toxic alcohol or bleach-based cleansers should be used with gentle scrubbing to prevent abrasions or damage to children’s thin skin. The water should be warmer than 36.6°C (98°F) to decrease the risk of hypothermia. In general, the younger and smaller the child the more important it is to pay attention to hypothermia, airway control, safety, and anxiety.⁹

Recommendations

The decontamination process differs slightly by age. Children are divided into three groups — infants and toddlers (typically <2 years), preschool children

(2 to 8 years), and school-age children (approximately 8 to 18 years).

Children are also placed into groups that are ambulatory (>2) and nonambulatory (<2 or injured) because nonambulatory children will need to be placed on a stretcher or restraining device prior to decontamination. This group will need assistance from caregivers or “hot zone” personnel to disrobe and be washed. Special attention should be given to the airway as the children are restrained. Infants and toddlers should not be carried due to the risk of the caregiver falling in the shower.

School-age children will need assistance with maintaining modesty and privacy while disrobing and showering.

CRITICAL DECISION

How should the medical community prepare for pediatric victims of an MCI?

Integrating pediatric needs into disaster planning is critical but often overlooked when disaster plans are developed. Training should focus on attempts to organize the chaos and educate emergency personnel about ways to protect their own safety while treating as many victims as possible.

Prevention and Mitigation

Prevention and mitigation involve the use of proactive and sustained actions to lessen or neutralize the impact of a disaster. It has been identified as the cornerstone of emergency management by the Federal Emergency Management Agency (FEMA).⁹ Conducting a pediatric-specific disaster risk assessment

Pearls

- Children inevitably will be involved in mass casualty incidents; disaster planning must include planning for pediatric victims.
- Disaster triage is a fluid and dynamic process; reassessment and reassignment are critical and dependent on the availability of resources.
- Children have anatomic, physiologic, and psychological differences that make them more vulnerable than adults in an MCI.
- Many countermeasures/antidotes/immunizations are not approved for typical pediatric use.



TABLE 1. LEVELS OF PERSONAL PROTECTIVE EQUIPMENT

Level	Description	Types of Materials Protected Against	Advantages	Disadvantages	Possible Scenarios
A	Fully encapsulated suit with self-contained breathing apparatus	Gases, vapors, aerosols, liquids, solids	Highest level of protection for inhaled and contact toxins	High training requirements, expensive, physical demands, poor mobility, limited air supply	Prehospital hot zone that has toxic gas or vapor, oxygen-poor environment
B	Encapsulated suit with seams sealed, self-contained breathing apparatus outside suit or supplied air respirator	Vapors, aerosols, liquids, solids	High level of protection, supplied air improves mobility, fit-testing needed	High training requirements, expensive, physical demands, dependence on air line or limited air supply	Prehospital warm zone that has toxic solids and liquids and may have toxic gases
C	Chemical-resistant splash suit with powered air-purifying respirator (PAPR)	Vapors, aerosols, liquids, solids	High level of protection, improved mobility, decreased expense and training requirements, lower physical demands, no fit-testing needed	Not adequate for high concentrations of toxic gases or high levels of splash	Hospital hot zone where toxins are liquid, solid, or low concentrations of vapors
D	Normal work clothes, gowns, gloves, eye/face shields	Minimal for solids	Full mobility, full operational time, low physical stress, low training level and expense	Little to no protection against chemical or other toxins	Hospital cold zone after patient fully decontaminated

From: Heon D, Foltin G. Principles of Pediatric Decontamination. *Clin Pediatr Emerg*. 2009;10(3):186-194. Used with permission.

or hazard vulnerability analysis can determine the types of hazards in different settings that have a high, medium, or low probability of occurring. Although a large-scale intentional chemical or bioagent event is scary, a more likely MCI involves natural disasters, accidental spills, or multiple trauma (eg, bus accident or gun violence).

Prehospital and hospital providers should complete formal, ongoing training in the emergency management of children. Education should include information on childhood growth and development, appropriate pediatric triage, and the management of children with special health care needs. Recommended pediatric training courses include Advanced Pediatric Life Support (APLS), Advanced Trauma Life Support (ATLS), Emergency Nursing Pediatric Course (ENPC), Neonatal Resuscitation Program (NRP), Pediatric Advanced Life Support (PALS), Pediatric Education for

Prehospital Professionals (PEPP), and School Nurse Emergency Care (SNEC).

Plans for partnerships and collaboration should be developed among agencies that care for pediatric victims. These may include state emergency response teams, local law enforcement, fire departments, children's and general hospitals, public health services, mental health care organizations, schools, and faith-based organizations.

Game Plan

Preparedness involves the predisaster groundwork that enables systems to respond in an MCI.¹⁰ The National Incident Management System (NIMS) has outlined response processes, protocols, and procedures to adopt during an MCI. An incident command center should be instituted to coordinate triage, transport, decontamination, care, etc.

Disaster drills should include pediatric victims, including those with special

health care and emotional needs.

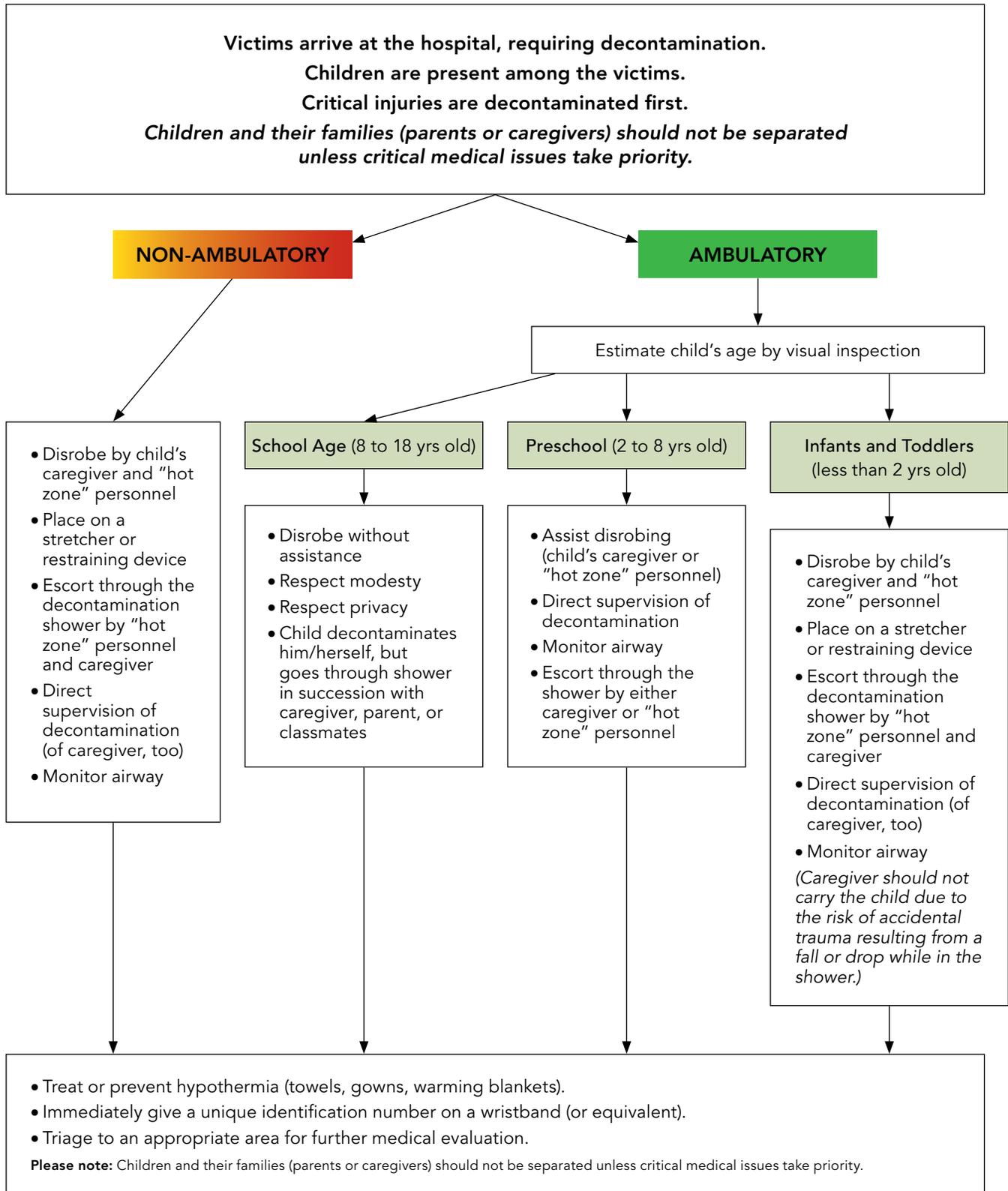
Disaster planning committees should include those with expertise in handling pediatric critical illness or injury such as physicians and nurses with pediatric subspecialty experience and child life specialists.

Pediatric protocols/guidelines should be available at each institution and should specifically address the unique needs of children. The AAP's "Children, Terrorism & Disasters Toolkit" identifies distinct vulnerabilities of children to biological, chemical, and other terrorist attacks, and highlights their unique treatment needs.

Supplies

There should be a plan in place to increase pediatric surge capacity, including the utilization of alternative care areas in the hospital (outpatient procedure beds, hallways, cafeteria, conference rooms), as well as outside the

FIGURE 3. HOSPITAL DECONTAMINATION AND THE PEDIATRIC PATIENT, MODEL PROTOCOL ALGORITHM



Heon D, Foltin G. Principles of Pediatric Decontamination. *Clin Pediatr Emerg.* 2009;10(3):186-194. Used with permission.

hospital (rehabilitation facilities, mobile clinics, hospital-based ambulances, faith-based facilities, fitness centers, schools).

Extra staff with pediatric expertise may include those from other hospitals and out of state, and there should be a plan for malpractice coverage and the expedited credentialing of these providers. There should be immediate access to supplies of unexpired equipment, nutrition, vaccines, and medications for staff and patients, with plans for keeping these secure and restocked. Pediatric-specific equipment should be readily available with a mechanism to obtain additional supplies quickly. There should also be supplies of pediatric-friendly equipment such as cribs, toys, and blankets.

A method of estimating weight is crucial, as most medication doses for children are weight based. One widely used method is a color-coded tape measure that uses the patient's length to help estimate weight, which is then keyed to appropriate dosages and equipment sizes. Some facilities have beds with scales that can weigh patients.

Special Considerations

Transfer agreements should be in place to transport critically ill children to tertiary pediatric hospitals and move adults from pediatric hospitals to general hospitals.

Families of children with special health care needs should be educated prior to an MCI about how to prepare and respond to an emergency or disaster. Resources include contact information for local hospitals, EMS, and utility companies; identification of "medical home" partners, primary care providers, special care providers, and medical equipment suppliers, and where to go for electricity (eg, in ventilator-dependent patients). Parents/caregivers should also have multiple copies of the Emergency Information Form recommended by the AAP and ACEP.¹¹

Legal issues can arise regarding decontamination procedures and the separation of children from their parents. Plans for billing and malpractice should be addressed prior to an MCI (eg, will billing and documentation be

suspended?), as should issues related to nonpediatric subspecialists caring for critically ill pediatric victims.

Security plans should be in place to ensure the safety of unattended children and address temporary guardianship and family reunification. Medical personnel must be prepared to facilitate the identification of children by relatives (eg, pictures, descriptions, names) and have a system to track patients and their belongings. A protocol for quarantining infected/exposed children or hospital staff also is critically important.

A system also should be in place related to media and communications, defining what information is disseminated, by whom, and when. This can prevent mass panic, keep the public informed, provide important health education, and help reunite families.

Response and Recovery

The initial response identifies the situation, including information about the incident, type of injuries/exposure, and potential number of victims. It also activates pediatric providers and preidentified credentialed disaster team members such as incident commanders, nursing coordinators, and pediatric subspecialists.

Some children have special transport needs during evacuation (eg, incubators or warmers for newborns and infants). Patients on ventilators should be hand-bagged by qualified personnel such as respiratory therapists.

Recovery involves rebuilding the community so normal life can resume.

The facility's incident command system, triage, decontamination, and treatment protocols should all be reviewed after an MCI to identify opportunities for improvement and modification.

Catastrophic events can have both acute and long-term psychological consequences in children, who are especially at risk of post-traumatic stress. They may need referrals to local psychiatric resources to address issues of safety, guilt, feelings of injustice, loss of loved ones, and a return to everyday routines.

Summary

Although it is reasonable to plan for a large-scale chemical or bioagent event, natural disasters, accidental spills, and multiple traumas are more likely to occur. Training should focus on organizing the chaos while educating emergency personnel about how to protect their own safety and do the best for as many patients as possible. It is important for providers to:

- Know which types of MCIs are more likely to occur in their area and understand how to respond.
- Be familiar with their community and health facility disaster plans.
- Know how to recognize an MCI.
- Know the equipment and medications available.
- Prioritize the protection of medical personnel.
- Treat the patient first, not the toxin.
- Adapt from daily triage to disaster triage.
- Utilize resources wisely.



Pitfalls

- Not having a pediatric-specific disaster plan in place prior to an MCI.
- Not following the tenets of mass casualty triage, regardless of the method used: "To do the greatest amount of good for the greatest number of patients."
- Not recognizing/paying attention to abnormal vital signs. (Tachycardia is the first sign of shock in children.)
- Not recognizing an event has occurred and not providing appropriate decontamination.

CASE RESOLUTIONS

■ CASE ONE

Using the JumpSTART method, the five victims were triaged.

Victim 1. The girl with the injured leg was breathing spontaneously and had a palpable pulse. Her responses to the AVPU assessment were appropriate, so she was placed in the delayed (yellow) category and placed in the first ambulance for transport.

Victim 2. The pulseless 5-year-old boy was lying face down, not moving, and not breathing spontaneously. He remained apneic and pulseless, despite being given rescue breaths, and was categorized as expectant (black); no further interventions were needed.

Victim 3. The teenage boy with a bloody shirt was lying supine and nearly motionless, gasping for air, and moaning. He had a pulse rate of 40, and a respiratory rate of 10, which supported an immediate (red) categorization. He was intubated by EMS, and placed in the first ambulance for transport.

Victim 4. The 4-year-old girl with a bloody head had a pulse rate of 140, and respiratory rate of 28. She was able to walk, so she was categorized as minor (green). She continued

to cry and her vital signs remained stable, so she became third in line to be transported.

Victim 5. The 9-year-old girl was lying supine with agonal respirations, a barely palpable pulse, and an apparent gunshot wound to the face. Her airway was repositioned, but she remained apneic; five rescue breaths were given and spontaneous respiratory effort was noted. She was classed as immediate (red), and resuscitation efforts were continued. EMS administered supplemental oxygen by nasal cannula and established an intravenous line. She was the second victim to be transported.

■ CASE TWO

Given the concern for potential chemical exposure, every patient involved in the highway collision required decontamination on arrival, even prior to the administration of lifesaving interventions. A decontamination tent was set up to protect the emergency department from becoming a “hot zone,” and personal protective equipment was provided for the medical staff. Multiple victims with minor injuries, who arrived directly from the scene by private car, also required decontamination prior to treatment.

The physician activated the disaster plan instituted by his hospital, which included consulting with the incident commander; administrator on call; emergency department charge nurse; and floor, operating room, and critical care units before declaring this a disaster.

Symptoms of rhonchi, wheezing, hypoxia, bradycardia, and hypotension were seen in many patients, and seizures and coma in a few. The emergency physician recognized a cholinergic toxidrome. Supplies of atropine and pralidoxime were obtained from the pharmacy, and a request was made for an additional emergency shipment from the local warehouse. The exposure was later confirmed to be an organophosphate, which has similar effects to nerve agent toxicity.

Using JumpSTART, clinicians wearing full protective gear assessed the woman being bagged immediately on arrival and declared her expectant (black); care ceased. The distraught 6-year-old boy was designated for minor (green) care and placed with a social worker while awaiting the arrival of relatives. The quiet infant was triaged to immediate (red) care after being decontaminated.

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