

Pediatric Hospital Surge Capacity in Public Health Emergencies

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Introduction

The special medical needs of children make it essential that health care facilities be prepared for both pediatric and adult victims of bioterrorism attacks, including those resulting from dispersal of airborne or foodborne agents.^{1,2} Moreover, while terrorist attacks on the United States have provoked the development of guidelines for hospital responses to acts of bioterrorism, few have focused on pediatric facilities.² Compounding the problem is that many disaster plans that have been designed for children's hospitals are not designed to accommodate large numbers of contagious individuals capable of disseminating highly lethal infectious agents.

This document is designed to address the topic of converting pediatric hospitals from standard operating capacity to surge capacity in response to large numbers of children with communicable airborne and foodborne agents. A secondary goal is to assist general emergency departments in developing plans to provide care to large numbers of critically ill pediatric patients. With the recommendations provided in this review, clinicians and hospital administrators will be able to develop unique responses to mass casualty events involving pediatric patients who are victims of bioterrorism. Following the all-hazards approach, the recommendations within this monograph can also be used in consequence management after the exposure to emerging infections of public health importance such as pandemic influenza.

Definitions

For the purposes of this document, we will use the definitions that follow.

1. **Child:** One who fits within the parameters of a Broselow-Luten Resuscitation Tape (“Broselow Tape”), a common tool used in pediatric emergencies to determine a child's weight, drug doses, and the size of resuscitation equipment. Typically, the Broselow Tape is designed to be applied to children ages 12 and under.
2. **Pediatric Hospital:** An accredited health care facility dedicated to the specialized care of infants, children, and adolescents. Although adults may occasionally be treated for medical conditions in these facilities, the expertise of a pediatric hospital is focused on caring for patients 21 years old or younger.
3. **Surge Capacity:** The ability of a health care facility to provide medical care in excess of the standard operating capacity. In this monograph, the term will refer to increases in patient volume from external emergencies.
4. **Biological Weapon:** A biological entity, whether wild-type, genetically altered, or weaponized, that is used to incite terror by producing disease in a portion of a target population.
5. **Airborne Pathogen:** A disease-causing agent that can reside in an air stream. In the context of this monograph, an airborne pathogen will be considered to be an infectious agent. Two types of airborne pathogens exist—communicable and noncommunicable.

- a. Communicable airborne pathogens are those that are transmissible from one individual to another by means of respiratory droplets or another body fluid. Examples of these pathogens include smallpox, plague, Ebola, and other viral hemorrhagic fevers.
 - b. Noncommunicable airborne pathogens are those agents that cause disease by direct contact and are not transmitted secondarily from person to person. Examples of these pathogens are anthrax and tularemia.
6. **Foodborne and Waterborne Pathogens:** A foodborne pathogen produces illness as a result of consuming a particular food. A foodborne illness outbreak is the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food. Infectious agents that produce illness after consumption or use of water intended for drinking, or illnesses associated with recreational water such as swimming pools, water parks, and naturally occurring fresh and marine surface waters are waterborne pathogens.

Challenges to an Effective Response to Patient Surges

To respond effectively to bioterrorism or other infectious outbreaks, both pediatric and nonpediatric health care facilities must 1) recognize the incident in its early stages, 2) activate existing surge capacity plans, 3) adequately prepare for consequence management after such incidents, and 4) provide adequate logistical support for increased patient volume.

Difficulties in Recognizing an Outbreak

Diseases spread by the airborne route have great epidemic potential in those without immunity to the organism, and the ability to recognize such an epidemic is inhibited by the delay between exposure to a bioweapon and the development of clinical symptoms. The ability to identify a bioweapon remains critical to the planning for and management of an outbreak; the same holds true for recognizing a natural outbreak. Experience with the outbreak of the Severe Acute Respiratory Syndrome (SARS) demonstrated that epidemiologic history and tracing patients' travels were critically important in understanding the patterns of disease spread. Unfortunately, many clinicians who work in an emergency setting receive minimal training in traditional epidemiologic methods, or they do not have the time to apply them.

Access to surveillance systems capable of informing clinicians about terrorist attacks can quicken response to a sudden surge of patients. For example, poison control centers are linked to a single nationwide database that is updated within minutes; the goal of this database is to rapidly identify and disseminate information about sentinel events back to poison control centers and then to local clinicians. Physicians who access this important information source will receive timely notification of developing outbreaks of various types.

Reluctance to Activate the Surge Capacity Plan

Activation of the surge capacity plan signals the absolute need for transition from normal hospital operations to a disaster footing. Because of the unknown extent and expense of the response, however, clinicians may hesitate to activate the plan. Alternatively, emergency physicians who have become inured to severely crowded conditions may be unaware that activation of the surge capacity plan is warranted when there is a large influx of pediatric patients.

Logistics: Deployment of Hospital Personnel

Effective surge capacity plans require brisk responses at institutional and departmental levels that are supervised by a designated team of individuals following a defined command structure. An organized and well-communicated response can support well-

designed surge capacity plans, heighten the benefit of disaster drills, improve the efficiency of hospital operations, and foster the delivery of good quality patient care.

The Emergency Department (ED)

As with any disaster, the ED bears the brunt of the patient inflow into a health care facility. ED operations, the efficiency of which are severely compromised by overcrowding, are further hampered by intentional capacity-to-demand mismatch promoted by hospital administrations to ensure that inpatient bed spaces are never wasted.³ Hospital administrations, credentialing organizations, and Federal, State, and local agencies need to eliminate or minimize ED overcrowding to ensure good quality patient care in the event of a terrorist attack.

Critical Care

A dramatic number of patients exposed to a bioweapon may become critically ill. An excessive volume of high-acuity children will place extreme pressures on the clinicians staffing intensive care units, particularly if critically ill patients have significant respiratory illness or involvement of multiple organ systems. Critical care staff may be required to assist in patient resuscitation in the ED as well as the traditional intensive care setting.

Respiratory Care and Radiology

Patient surges may overwhelm the ability of respiratory therapists to provide adequate care to critically ill children. Excess patient load, especially patients with significant respiratory demands, may prevent the adherence to hospital standards for ventilator management, respiratory care, and pulmonary toilet. Hospitals may lack an adequate number of positive-pressure ventilators to effect the degree of activation of a pediatric surge capacity plan. Moreover, respiratory therapists may be at increased risk for infection during procedures such as orotracheal intubation and administration of nebulized therapy. This risks attrition of the available workforce.

Nursing

The numbers of patients who can be admitted to hospital floors is typically determined by the ratio of nurses to patients. In the event of a surge of high-acuity children, nursing staff may need to provide care for greater numbers of sicker patients, at least until additional staff can be mobilized through the surge capacity plan.

Ancillary Staff (Security, Engineering and Environmental Services, and Public Affairs)

Controlling the flow of patients, families, and visitors into a health care facility is vitally important after a disaster. A breach of hospital security can lead to unnecessary exposure

of staff to infected victims, spread of disease, and contamination of “clean” hospital areas. Engineering services may be needed to construct ventilation barriers that can isolate entire floors from the remainder of the facility. Adequate disposal of contaminated materials by environmental services personnel is necessary to avoid contamination of hospital areas. Lastly, centrally controlling communication messages sent to staff, patients, and the public is an important role for Public Affairs, as it improves the response by providing clear, consistent communication while decreasing rumors.

Logistics: Insufficient Resources for Communicable Disease Control

Both pediatric and general hospitals may have insufficient resources to control the spread of communicable diseases. Surges of patients may overwhelm the number of respiratory isolation rooms and permit the spread of airborne pathogens into “clean” hospital areas, a problem that would be exacerbated by inadequate air exchange ensured by antiquated heating-ventilation-air conditioning (HVAC) units.⁴ If multiple patients are cohorted in multi-bed rooms, the distance between beds may be insufficient to prevent the spread of airborne pathogens.⁴ In locations such as the ED, there are many challenges to preventing the spread of infectious agents. Many patient bed spaces are separated only by a curtain; patients may share a common bathroom. Moreover, most EDs have washbasins for which water flow is activated by turning a faucet handle rather than using a motion or body heat sensor; the latter feature avoids direct contact with bathroom hardware and prevents the spread of foodborne pathogens transmitted in the stool.

Logistics: Maintaining an Adequate Supply of Hospital Stocks

An increased volume of critically ill patients may completely deplete available supplies of ventilators, respiratory isolation gowns, N95 respirators, sheets, medications, intravenous supplies, and other material. For example, to prevent the spread of disease from patients requiring respiratory support after infection with an airborne pathogen, clean gowns, N95 respirators, and bag-valve-mask devices (“ambubags”) must be used for each patient. Furthermore, clinicians should change gowns, gloves, and N95 respirators when entering each patient room to avoid the spread of disease.

Unique Challenges Posed by Pediatric Mass Casualty Incidents

The release of a biological weapon would disproportionately affect children through several mechanisms.^{1,2} With aerosolized agents (e.g., anthrax), increased respiratory minute ventilation in children (500 ml/Kg/min) compared with adults (140 ml/Kg/min) results in the child’s exposure to a relatively greater inoculum.¹ The high vapor density of bioaerosols, such as those potentially used to disseminate airborne pathogens, places their highest concentration close to the ground in the lower breathing zone of children.¹ The more permeable skin of newborns and children in conjunction with a larger surface-to-mass ratio results in greater exposure to transdermally absorbed toxicants.¹ Children, because of their relatively larger body surface area, lose heat quickly when showered.¹

Consequently, skin decontamination with water may result in hypothermia unless heating lamps and other warming equipment are used.¹ Having less fluid reserve increases the child's risk of rapid dehydration or frank shock after vomiting and diarrhea.¹ Finally, children have significant developmental vulnerabilities.¹ Infants, toddlers, and young children do not have the motor skills to escape from the site of a biological incident.¹ Even if they are able to walk, they may not have the cognitive insight to decide in which direction to flee.¹ All children are at risk of psychological injury, such as posttraumatic stress disorder, from experiencing or witnessing an act of terrorism.^{1,5} In a mass casualty incident, children witness injuries and deaths, possibly of their parents, which would produce both short- and long-term psychological trauma that requires intervention.¹

Children are difficult to care for by health care personnel wearing protective equipment, which is essential in the management of chemical, biological, and radiological events. Protective clothing is bulky and cumbersome; it impedes the ability of health care providers to perform procedures such as venipuncture or endotracheal intubation on small children.

Guidelines for Pediatric Hospital Responses to Increased Patient Volume

Activation of the surge capacity plan should be performed either on hospital notification (from police, emergency medical services control, public health officials, or another established mechanism) that a mass casualty event has occurred, or once clinicians in the ED have made the determination of need.

Activation of the Surge Capacity Plan: The Hospital Incident Command System (HICS)—Hospital Command Group⁶

The emergency physician who activates the hospital surge capacity plan should contact hospital telecommunications personnel (“operators”) who must, in turn, notify essential personnel. Hospital operators should also be responsible for notifying personnel when the surge capacity plan is deactivated.

Once a surge capacity plan is activated, a defined group of individuals known as the **Hospital Command Group (HCG)** (Figure 1) should convene in a location identified as the **Hospital Command Center (HCC)**. The HCG typically receives valuable input from the emergency department attending (serving as the Medical Technical Specialist: Medical Staff Officer) and comprises the Administrator on Duty (Incident Commander), Public Information Officer, Safety Officer, Liaison Officer, as well as other members of hospital leadership. Although the exact responsibilities of each member are unique to the specific disaster plans for each health care facility, the HCG has responsibility to:

- Activate the necessary HICS positions

- Coordinate the institutional response to the surge capacity plan
- Receive, interpret, and communicate information from emergency medical services and public health communication networks, including updates of the facility's bed capacity
- Coordinate hospital activities during activation of the surge capacity plan
- Rapidly discharge inpatients capable of outpatient or delayed management
- Monitor the flow of disaster patients as they move through the hospital's systems
- Receive and communicate information between hospital departments
- Ensure that elective admissions are postponed, depending on the scope of the disaster
- Formulate plans for the next operational period
- Determine recovery strategies and devolution of the surge capacity plan

Each member should be clearly identified by means such as a vest with the wearer's responsibility written on it (e.g. Medical Technical Specialist: Medical Staff Officer). Each member should also read his/her facility-specific HICS Job Action Sheets that delineate individual responsibilities during the disaster. The ED Disaster Team Leader (physician leadership based in the ED) should designate a predetermined location in the ED as the ED Disaster Command Post. Here, the ED-based strategies are formulated and management objectives are defined. These strategies are shared with the HCC staff to better coordinate surge activities outside of the ED. Once the surge capacity plan is activated, each member of the HCG should immediately attend a status/action plan meeting in the HCC. Any communication with patient families or the press must remain under the control of the Public Information Officer who works with the Incident Commander and the Medical Technical Specialist: Medical Staff Officer. Once convened, the HCG priorities should include:

- Ensure that primary response and support departments (nursing, critical care, radiology, respiratory care, security, janitorial services, etc.) have received the alert and are prepared.
- Receive briefing from the Situation Team Leader regarding patient census and bed status.
- Consider canceling elective procedures and admissions.
- Ensure Logistics Section Chief is able to deploy resources as needed.
- Ensure contact with senior hospital executives.
- Activate the Documentation Team Leader individual to maintain the Incident Action Plan for post-incident debrief notes.

The HCC should be stocked with sufficient supplies to ensure operations of the HCG. Supplies should include communication sets, clerical supplies, redundant communication systems, mobile communication assets, HICS Incident Team Chart, hospital and city emergency contact directories, WebEOC and State Bed Tracking site log-in information, disaster related tracking forms, hospital charts, patient flow board, and reference documents such as triage protocols, surge capacity plans, patient reporting guidelines, HICS Job Action Sheets, area maps, copies of vendor memoranda of understanding, and risk communication templates and protocols.

Communication sets should not interfere with other networks used by the police, emergency medical services, and fire departments. Tactical radio channels such as those used for local communications have many different configurations. Some systems are dedicated EMS channels, some share channels with fire or police operations, and others have special channels for on-scene operations. In a small event, such as a motor vehicle crash, first response agencies may operate on a single channel. As operational complexity increases, incident commanders should decide the point at which communications transition from a single channel to a tactical (or “on-scene”) channel. The use of tactical channels prevents the overload of the primary EMS channel and prevents interference between agencies with different primary function. The incident commander or Medical Technical Specialist: Medical Staff Officer from the ED and other agencies should, however, communicate on a predesignated (mass casualty incident) channel when needed.

Emergency department communication nets should use multichannel portable radios that have talkaround capacity, although these systems are susceptible to missed messages if a dispatcher transmits over direct messages. Usually the portable radios used in ED communications are relatively low power and therefore have a limited service radius.

Several items can improve communications efficiency. First, an adequate supply of batteries for portable radios should be readily available to keep communications open as long as necessary. Second, it is important to use plain English and avoid coded language. This decreases the amount of radio traffic by eliminating phrases such as “at this time” or “be advised” and greatly decreases the potential for miscommunication. Third, radio users should remember to key the radio for a full second before speaking to ensure the beginning of the message is not missed.

Not all mass casualty incidents demand a hospital-wide response. For example, incidents that involve one or two clinical areas that can be handled with normal hospital staffing and are resolved in less than 8 hours can be often be handled with improved coordination between clinical services. In these limited cases, a Labor Pool can be staffed with minimal personnel to assist the activated HICS members with information management and to relieve workload on specific services (e.g., patient transport or radiology). Examples of these incidents include: alteration of ED operations without immediate threat to life or property, one or two operational areas involved (e.g., ED and radiology), considerable media attention, or an initial response to an unconfirmed external emergency.

Emergency Department Response: Surge of Children With a Communicable Respiratory Illness

All disaster patients should be triaged immediately on arrival according to the protocol described below.

Reverse Triage

Before patients can be handled safely in any ED, the medical facility that supports ED operations must have adequate bed space into which ED patients may be admitted. As Kelen has described, in a surge environment, reverse triage—the process of determining risk for discharge of inpatients—assumes a critical role. Stratifying risk into minimal (a limit of risk of adverse medical events in the next 72 hours of 3.8 percent); moderate (a limit of risk for consequential events in the next 72 hours of 33 percent); high (limit of risk of 61 percent); and very high (92 percent limit of risk) categories, patient disposition can be identified. Minimal and low risk patients may be sent home; moderate risk patients may deserve immediate transfer to another facility since they may be too sick for simple discharge home. High risk patients require highly skilled care during transport to major acute-care facilities, while very high risk patients may tolerate only ICU-capable transport—if they are stable for transport at all.⁷

Triage

Health care facilities should use a pediatric-specific triage system known by all hospital personnel.⁸⁻¹⁰ The use of standardized triage algorithms will provide guidance for triage personnel making potential life and death decisions that otherwise might be influenced by emotional issues.^{8,9} Depending on the volume of children arriving at a health care facility, clinicians may elect to use one of two assessment tools. In the event of very large numbers of patients arriving at an ED simultaneously, the Pediatric Assessment Triangle (PAT) suggests the urgency with which treatment should be initiated (Figure 2).⁹ This assessment tool relies on appearance of the patient to determine the severity of illness, the need for treatment, and the response to therapy.⁹ By using only visual and auditory assessments to develop an initial impression of a pediatric victim, PAT allows clinicians to rapidly identify patients with physiologic instability without using sophisticated monitoring techniques.⁹ The components include appearance, peripheral perfusion, and respiratory effort.⁹ The PAT is a simple tool that may be applied during any patient encounter; clinicians should practice applying PAT during routine emergency care to increase familiarity with the method.⁹

Slower patient arrival and intake may permit the use of another assessment tool, the JumpSTART Pediatric Multiple Casualty Incident Triage system (Figures 2, 3).^{8,9} This triage protocol is based on an assessment of respiration, perfusion, and mental status (RPM).^{8,9} The JumpSTART system is modified from a triage system developed for

adults; the modification to pediatric triage is based on known differences between adults and children in terms of risks and patterns of respiratory failure/arrest.^{8,9} Unless there is a clear external airway obstruction or compression, or internal obstruction from a foreign body, respiratory failure in adults usually follows massive head injury or circulatory failure.^{8,9} In this context, an apneic adult has likely suffered sufficient cardiac insult to preclude successful resuscitation in a mass casualty setting.^{8,9} In children, however, circulatory collapse often follows respiratory failure.⁸ Children may develop apnea relatively rapidly for mechanical reasons (e.g., weak respiratory musculature or inhibition of diaphragmatic excursion), rather than after a prolonged period of hypoxia. For this reason, a trial of intubation during a period of brief salvageability is a “jumpstart” for the child.⁹ It also means that increased pressure to respond quickly and effectively will be placed on respiratory personnel during a surge.⁹

Step 1: All children who can walk should be directed toward an area designated for **minor** injuries, where secondary triage will occur.⁹ Secondary triage should, at a minimum, employ the RPM components of the JumpSTART algorithm.⁹ Infants who are developmentally unable to walk should be screened at the initial site using the JumpSTART algorithm; an infant who satisfies all of the “delayed” criteria may be triaged to the minor category (see Figure 3).⁹

Special consideration should be given to children with medical conditions that prevent ambulation (e.g., mental retardation-cerebral palsy). These individuals can be triaged in a manner similar to infants.⁹ Clinicians should be aware, however, that patients with chronic respiratory problems may have an elevated respiratory rate at baseline. Moreover, an assessment of the neurological examination may prove difficult without an understanding of baseline function. Emergency personnel should, therefore, attempt to retrieve information from any available source.^{8,9}

Step 2A: Nonambulatory patients should be assessed for the presence of spontaneous breathing. Any patient with spontaneous respiratory effort should then have respiratory rate determined.⁹ Any patient with duration of apnea of greater than 10 seconds must have the airway assessed; any obvious foreign bodies should be removed by finger sweep.⁹ Otherwise, the airway should be opened by maneuvers such as chin lift/jaw thrust. If the patient regains spontaneous respiratory effort, the triage officer or his designee classifies the patient as **immediate** (red tag) and moves on.⁹

Step 2B: If spontaneous respirations do not return upper airway opening, the triage officer or his designee should palpate for peripheral pulses in the radial, brachial, and dorsalis pedis arteries. The absence of peripheral pulses warrants a triage category of deceased.⁹

Step 2C: If there is a palpable peripheral pulse, the triage officer or his designee will administer five rescue breaths using a bag-valve-mask device. The use of a mouth-to-mask device, as suggested by some protocols, is contraindicated in patients suffering exposure from airborne bioterror agents. If ventilatory trial fails to trigger spontaneous respiration, the child is classified as deceased.⁹

Step 3: At this point in the triage protocol, all patients have spontaneous respirations. Patients with a respiratory rate of 15-45 breaths per minute move to Step 4. Patients with respiratory rates less than 15, greater than 45, or with irregular breathing are classified as **immediate** (red tag), and the triage officer or his designee moves on.⁹

Step 4: At this point in the triage protocol, all patients have been determined to have adequate respiratory effort and rate. The triage officer or his designee should now assess perfusion by palpation of peripheral pulses.⁹ Because a terrorist attack may occur during winter months, and decontamination will be performed out-of-doors in a potentially cold environment, capillary refill should not be used to assess perfusion. The palpation of pulses is a tactile method that adapts well to poor environmental conditions. If there are palpable peripheral pulses, the triage officer or his designee assesses mental status (STEP 5). If there are no palpable pulses, the patient is classified as **immediate** (red tag), and the triage officer or his designee moves on.⁹

Step 5: For all patients at this point, the triage officer performs a developmentally-tailored “AVPU” assessment. If the child is alert, responds to voice, or responds appropriately to pain (e.g., localizes the painful stimulus or pushes it away), the patient is classified as **delayed** (yellow tag). If the child does not respond to voice and responds inappropriately to pain (e.g., makes noise or moves in a nonlocalizing fashion), has decorticate posturing, or is truly unresponsive, the patient is classified as **immediate** (red tag).⁹

Personal Protective Equipment and the Triage Location

Triage areas in medical care facilities should be considered “hot zones”—areas in which the greatest risk for contamination occurs. This designation is distinct from field MCI operations, where the triage location is considered to be a “warm zone”—an area defined by a perimeter inside which no or an acceptable level of contamination exists. Based on this definition, an entire health care facility could be considered a “warm zone,” which poses a risk of exposure to contaminated victims and equipment.

In general, early recognition of the type of exposure is based on the signs and symptoms demonstrated by patients. The type of exposure, in turn, determines the level of protective gear used by individuals in triage and patient decontamination. ED personnel handling victims contaminated with bioweapons in liquid or powder form require respiratory protection. Skin protection is largely unnecessary because bioterror agents are not absorbed through unbroken skin.^{1,9} Personnel handling victims exposed to aerosols do not require protective equipment since secondary aerosolization of residual agent from clothing, skin, hair, or exhaled air is usually insignificant.¹ In all cases, standard hygiene (e.g., hand washing) should be employed.

The location at which triage occurs will be determined in part by the number of patients presenting to the health care facility. For example, triage may occur in the ambulance bay of the emergency department, in the lobby of the hospital, or in driveways, traffic circles,

or other areas normally used by vehicular traffic. Triage teams should report to the triage location determined by the Incident Commander. The exact composition of triage teams may vary with the time of day and week depending on staffing levels. The composition and number of triage teams should be codified prior to a disaster.⁹

Patient Recordkeeping

Disaster patients should be assigned a prepared medical record number (Disaster Patient 1, Disaster Patient 2, etc.). Hospitals should have 500 such numbers prepared. As time permits, registration staff will work to establish patient identity. Transport of patients will be via wheelchair or stretcher, but portable isolation units are available to facilitate safe transport. As a patient moves into a new location, the Incident Command Center receives telephone notification of the change.

Patient Care in the ED

On notification of a surge of patients, the ED staff should prepare to access hospital-generated, pre-positioned stocks of vascular access supplies (e.g., interosseous needles), respiratory materials (“ambu bags”), Broselow tapes (if routinely used), and antidotes. Supplies should be stored in the ED or in a convenient location such as a storage locker in the hospital ambulance bay.

Depending on the size of the disaster, various State and regional medical supplies may be requested, as well as the U.S. Centers for Disease Control and Prevention-sponsored Strategic National Stockpile (SNS).^{14, 15} The SNS is a national repository of antibiotics, chemical antidotes, antitoxins, life-support medications, airway maintenance supplies, and medical/surgical items.^{14, 15} The SNS is intended to supplement and resupply State and local public health agencies in the event of a national emergency.¹⁴ The SNS involves a flexible response.^{14, 15} The first line of support lies within the immediate response in “Push Packages”; these are caches of pharmaceuticals and medical supplies. Although these Federal assets are designed for delivery within 12 hours of the Federal decision to deploy SNS assets, local planners should first use available State and local resources.^{14, 15} Clinicians wishing to

Example: Smallpox Scenario

Smallpox is transmitted by respiratory droplets and airborne particles.¹¹ For victims of smallpox, triage should be performed outdoors in a well-ventilated area.¹² Triage teams should employ airborne, contact, and droplet precautions.^{12, 13} This level of protection requires either a fitted N95 respirator with goggles and face shield; alternatively, a powered air purifying respirator (PAPR) hood may be used. In addition, personnel must use hair cover, shoe cover, gloves, and disposable yellow gowns or Tyvek overalls

Triage should be performed outdoors in a well-ventilated area such as the ambulance bay or hospital driveway. Patients may need to be held in the triage area until the ED is prepared for intake of victims. Because victims may be exposed to cold in the outdoor environment, warming lights, disposable blankets, or other devices should be available for patient warming. Specific preparations that the ED may have to make in anticipation of victim intake include moving existing nonvictim patients from negative pressure rooms or the discharge or transport of all patients from the ED.

access the SNS should contact their State's department of public health who will in turn call for the governor's office to request the release of the SNS.^{15*}

A surge of patients carrying a communicable respiratory illness will require significant modifications of standard ED disaster practice. Typically, patients from a disaster are managed in a single geographical location in the ED, while non-disaster patients ("non-disaster patient flow" or "worried well") are treated in separate areas.⁶ The arrival of patients with infections that may be spread by airborne route may compel striking changes in the management of patient surges. For example, patient volumes that outstrip the number of isolation beds place the entire ED—including its patients and staff—at risk for exposure.¹² The influx of patients infected with an airborne agent may require that all non-disaster patients be discharged or diverted from the receiving facility to avoid exposure and spread. These locations for diversion include the hospital auditorium, schools, or health care facilities not physically attached to the hospital (e.g., a neighborhood health center).

Scrupulous attention must therefore be paid to ensuring that patients remain isolated.¹² Multiple patients with proven infection may require placement in a single respiratory isolation room, or it may even be necessary to devote the entire ED to bioterrorism treatment, with all nondisaster patients being diverted elsewhere.

Effective patient isolation includes observing biohazard precautions. All staff should wear respiratory isolation garb suitable for droplet precautions.^{12, 13} Clinicians should employ airborne, droplet, and, if necessary, contact precautions. This level of protection requires either a fitted N95 respirator with goggles and face shield; alternatively, a powered air purifying respirator (PAPR) hood may be used.^{12, 13} In addition, personnel must use hair cover, shoe cover, gloves, and disposable yellow gowns or Tyvek overalls.¹² When exiting a patient care area, clinicians should observe the following steps.

At the door just prior to exit from the patient care area:

- a) Remove gloves by peeling them off inside out. Dispose of gloves in red bag trash.
- b) Remove isolation gowns by unfastening the back and with inside outward motion pull from top downward. Dispose of gown in red bag waste.
- c) Perform personal hygiene maneuvers, particularly hand washing.

Exit room.^{12, 13}

At the door just outside of room or in the anteroom:

- a) Remove hood respirator if used. Hood and battery pack must be cleaned before next re-use. Place the contents in a clean plastic bag.
- b) Remove face shield and discard.
- c) Remove goggles and discard.
- d) Remove N-95 respirator and discard.
- e) Perform personal hygiene.^{12, 13}

* Information about the Strategic National Stockpile is available from the Centers for Disease Control and Prevention at <http://www.bt.cdc.gov/stockpile/>.

The ED air handling system should be isolated from the remainder of the hospital. Ventilation systems that recycle mixed air from the ED and the facility may disseminate airborne pathogens to the remainder of the structure and force isolation of the entire facility. In preparation for the receipt of patients exposed to airborne bioterror agents, engineering services should review ED heating/ventilation/air conditioning systems, the age of air handling filters, and the dispersal of air withdrawn from the ED. Engineering services may be required to construct barriers to limit airflow in the ED and ensure that ventilation of the ED is maximized.

Emergency Department Response: Surge of Children With a Communicable Foodborne or Waterborne Illness

Reverse Triage

Reverse triage would apply to an outbreak of communicable foodborne or waterborne illness as it would with communicable respiratory illnesses. In the event of a foodborne or waterborne pathogen release, a surge of patients may be managed along lines that mimic standard disaster plans (e.g., victims may be handled in a single geographical location of the ED if patient volume permits).⁶ Nonetheless, some variations from standard disaster practice may be required. EDs often have a limited number of toilets for patient use. If victims suffer diarrhea, there may not be sufficient capacity to handle patient demands. Patients that use existing toilets may inadvertently contaminate the facility and increase the potential for transmission. To forestall this likelihood, every room in which a patient is assigned should have a dedicated toilet, either permanent or portable. All clinicians should follow rigorous handwashing discipline before entering and leaving patient rooms, and use gloves for all examinations. Gloved hands should not be placed on light switches, elevator buttons, keyboards, or any other surface that could promote disease spread.

Hospital Response to Patient Surge

A surge of children will require significant changes in every aspect of hospital operations. Individuals already within a hospital will need to be relocated to allow efficient operations during a surge. The actual locations should be defined in each individual facility's disaster plan, and telephone numbers for each area should be listed. Table 1 describes potential patient care activities and proposed locations to which patients or hospital personnel may be transported, if determined to be medically appropriate by the incident commander.

In addition to the above, specific elevators should be assigned for the transport of patients. Access to these dedicated elevators should be limited by security staff; their use should be restricted to individuals with an appropriate key or identification number.

Employee Responses During a Surge of Bioterrorism Patients

Each department and division within a health care facility should develop a personnel disaster tree, which is an algorithm by which all employees can be contacted in the event of a mass casualty incident. Once the medical physician in charge has identified a patient surge, hospital operators will contact department chairs, division chiefs, and unit directors. These persons will, in turn, contact their associate directors, nurse managers, or another associate. That person will contact two to three individuals under their supervision, each of whom will repeat the practice until all personnel have been notified. An important element of the disaster notification process is to make staffing requests for: 1) staff who can immediately respond to the disaster; 2) staff who will be responsible for relieving the current staff at the next operational period, and; 3) staff who are not being requested, but should remain on alert in case they are needed.

To serve as a redundant system for employee notification, all employees should report to their immediate supervisor or department manager. If the supervisor or manager is not in the hospital, that person should be contacted by telephone or hospital pager. Each department or workgroup should have specific responsibilities assigned to them; if there are no responsibilities assigned, then members of that department should report to the labor pool. Employees who are called into the hospital should have parking available in the most convenient lot. No employees should make any comment or responses to the media, nor should they respond to requests for patient information.

It may become necessary to use outside personnel or volunteers to assist with both clinical and non-clinical elements of the disaster response. For clinical licensed professionals, regulatory agencies like the Joint Commission have instituted clear disaster privileging protocols. Federal programs like Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP) and local Medical Reserve Corps programs are an attempt to organize potential health care responders should the need arise.

Any non-employee volunteers responding to support the incident by adding the logistic, supply and material distribution, administrative functions, or other forms of emergency response must be clearly identified as disaster volunteers and assigned a supervisor who will oversee their activities. This group of support personnel is typically protected from civil liability by falling under “Good Samaritan” laws.¹⁶ Table 2 describes the proposed responses of individual departments and workgroups within the hospital during a surge of bioterror patients.

Surge Stress Management

Most individuals—victims, rescue personnel, and health care workers alike—will demonstrate normal stress reactions that may persist for several days or weeks after a

disaster.¹⁷ Approximately one-third of survivors will develop severe stress reactions that place them at risk for acute anxiety syndromes in the immediate post-event period and post-traumatic stress disorder (PTSD) in the days to weeks afterward.^{17, 18} After a critical incident such as a surge of bioterrorism victims, stress management in the form of a mandatory meeting decreases negative effects of the incident on involved staff.¹⁸ The debriefing is a confidential, non-judgmental evaluation of the event, the hospital's response to it, and the staff's feelings about involvement in the event.¹⁸ It also helps the staff process events related to the surge and returns the workplace to normal equilibrium. The leadership of the debriefing session should be drawn from staff trained in critical incident stress management from psychiatry, social services, and other related fields.¹⁸ The debriefing session should ideally occur within 24 hours of the attack, but it may be delayed by necessity for up to 3 to 4 days afterward.¹⁸ Emerging evidence suggests, however, that these meetings may be counterproductive in some individuals; forcing personnel to "re-witness" the event may actually increase their despair and promote psychiatric decompensation.¹⁸

Preparation by General Health Care Facilities for a Surge of Critically Ill Children

All health care facilities, not simply pediatric hospitals, must be prepared for a surge of critically ill children.¹⁹ Although EMS field efforts will attempt to match the victims' needs with the nearest appropriate hospital, the most recent disaster literature suggest that up to 50 percent of the victims arriving at a hospital under surge (mass casualty) scenario will arrive by other means. To accommodate a possible surge of pediatric patients, hospitals that care for adult patients should ensure that adequate, up-to-date stocks of pediatric supplies—Broselow tapes, endotracheal tubes, intravenous catheters, interosseous needles, ambu bags, and other equipment—are on site.¹⁹ Lastly, adult-only hospitals should diligently practice pediatric disaster drills. These activities should also include all staff who may be called on to deliver care to children, including respiratory technicians, radiologists, and others.

A surge of ill children may present considerable staffing challenges to general and adult-only hospitals. Although physicians who have undergone residency training in emergency medicine are prepared to manage acutely ill children, many general hospitals have limited numbers of pediatricians and pediatric support staff (e.g., child life specialists) on staff. Consequently, adult-only hospitals should develop lists with accompanying contact information (e.g., pager numbers, office phone numbers, home phone numbers, and cell phone numbers) of locally available pediatricians and nurses who will report to the hospital in the event of a surge. In metropolitan areas, adult-only hospitals should draft memoranda of understanding with local pediatric hospitals. These memoranda should 1) delineate protocols for patient transfers and other direct patient-care activities between the two facilities; 2) provide for pediatric hospital clinicians to staff inpatient locations such as intensive care units and operating suites; and 3) extend emergency staff privileges to pediatricians who are acutely needed to provide medical care in adult-only facilities. The last two points are vitally important; patients from a

bioterror attack may not be appropriate for transfer and therefore must remain in the receiving facility. Since inpatient care is closely linked to that provided in the ED, sufficient numbers of pediatricians are required to staff inpatient beds, otherwise an ED will never decant its existing patient load and prepare for the arrival of more.

Security Concerns Unique to Children

Children caught up in a surge may be separated from parents. Siblings/families should be treated together whenever possible. If separation occurs, or if members are triaged to different levels of care, hospitals will need to establish a plan to ensure the security of these patients until the family can take custody.²⁰

Hospitals should designate and staff a holding area to supervise and support unaccompanied children.²⁰ General staffing guidelines—one adult per four infants or 10 preschool children or 20 school-aged children—may be superseded by local licensing standards for daycare.

To help track children, a Radio Frequency Identification Device (RFID) or barcode-based tracking system is optimal, but obtaining digital images of unaccompanied children is an alternative. In the event that cameras are unavailable, simply writing a description of general age, physical characteristics, clothing, and possessions can facilitate identification. Finally, the American Red Cross' Patient Connection Program can facilitate a focus on the delivery of medical care.²⁰

Emergency Credentialing

Surges that overwhelm a medical system may impel clinicians to offer temporary services. Even if hospitals can accomplish the unlikely goal of increasing capacity by 20-30 percent, these additional beds require staffing. Granting emergency privileges may alleviate staffing demands.²¹

Each hospital in a given geographical region may consider creating a database that includes all credentialed physicians, nurses, pharmacists, and ancillary staff. Once created, all databases can be combined into a master file that is stored centrally. In the event of a surge, medical personnel from unaffected areas can receive temporary credentialing for the duration of an emergency.²¹ Such an approach is inexpensive, accurate, and Joint Commission-compliant.²¹

Figure 1. Sample Hospital Incident Command System (HICS)—Hospital Command Group (HCG)

SAMPLE: HOSPITAL COMMAND GROUP (HCG)

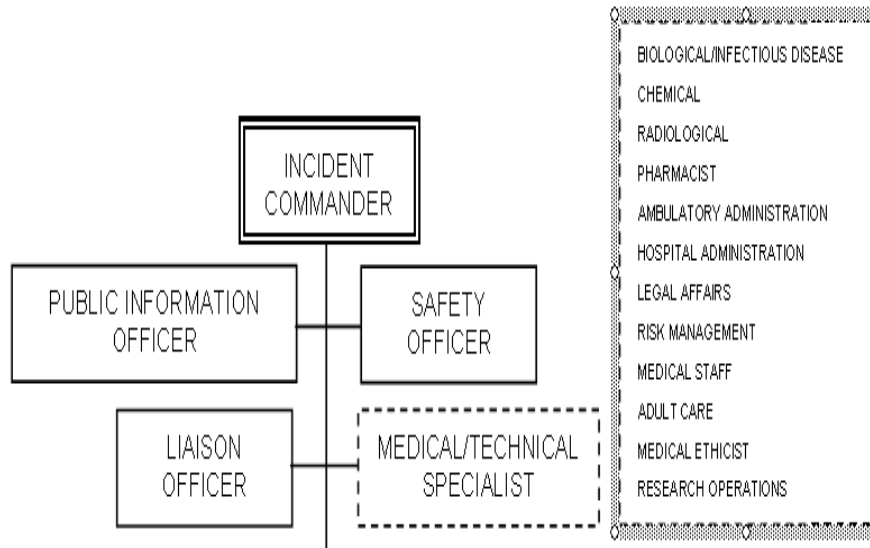


Table 1. Patient Care Activities and Proposed Locations

Activity	Area
Inpatients pending discharge	Cafeteria or another large open area
Preoperative care/minor surgery	Day Surgery
Emergency Department waiting room	Hospital Lobby
Triage and treatment of disaster patients	Emergency Department
Waiting area for family of disaster victims	Emergency Department Conference Room
Expired patients	Morgue
Patients requiring surgery	Main operating rooms
Postoperative patients	PACU
Admitted intensive care disaster patients	Pediatric ICU
Patients requiring radiology	Radiology
Disaster patients pending discharge	Hospital conference room or other large room
Messenger pool/hospital volunteers	Mid-sized conference room

Table 2. Employee Response During Patient Surge

Admitting	On notification of a surge of patients, the admitting department should follow Unidentified Patient protocols for all disaster patients; this frequently involves assigning predetermined medical record numbers that are retained throughout hospitalization. The admitting department should maintain a record of all elective admissions that have been cancelled.
Anesthesia	After notification of disaster, all anesthesiology staff not immediately involved in a case should report to the ED to assist in patient management as needed. Operating rooms should be made ready, and plans should be made to cancel elective cases. Depending on the level of operating room activity and the volume of patients, additional anesthesiology personnel may need to be summoned.
Blood bank	The director of the blood bank will contact the HCG to determine if any hemorrhaging patients have arrived or are expected. The blood bank will check inventory of blood to ensure appropriate amounts are in stock. If sufficient blood is not immediately available, the blood bank will contact outside suppliers for additional material. Because blood banks often have limited staffing on nights and weekends, the director of the blood bank will consult with the HCG to determine who shall transport blood to the ED.
Clinical laboratories	The laboratory supervisor will notify chemistry and hematology sections of the lab, as well as the laboratory director. The lab should follow the Unidentified Patient Policy protocols using the preassigned medical record number. The disaster patient retains this number throughout hospitalization.
Department of Medicine	The Department of Medicine should provide sufficient personnel to assist in the triage, resuscitation, and management of disaster patients in the ED; manage admitted patients; and provide

	<p>administrative and medical support for the discharge of inpatients.</p> <p>Chief medical residents should be notified by pager. These individuals, in turn, notify the remainder of the resident staff. The chief residents designate the staff who will assist the ED in triage/resuscitation/ED management. The chief residents will also identify those patients appropriate for immediate discharge. After details of the bioterror release are known, the chief medical residents will begin to discharge inpatients. Following discharge, the chief medical residents will review bed availability with the HCG.</p>
MICU	<p>The MICU fellow or senior resident is dispatched to the ED assess patient needs. The remainder of the MICU medical staff determines which patients can be discharged from the MICU in anticipation of disaster admissions. The MICU attending reassigns residents as needed, determines staffing needs, and calls in additional personnel to assist in patient management. The MICU charge nurse will periodically report to the HCG with bed availability.</p>
Nursing	<p>The nursing administrator on call will assume responsibility for coordinating nursing activities during the disaster. Once the hospital transitions to a disaster footing to handle surges of patients, the nursing administrator will meet with the HCG. The nursing supervisor will assist with inpatient census management, bed availability, and nursing availability. The nursing administrator should also prepare floor nurses for the potential for numbers of patients on medical floors that greatly exceed normal “maximum” census for that patient location.</p> <p>The nursing administrator should also be responsible for providing adequate nursing staff for the ED and disaster discharge areas. If disaster staffing needs exceed the</p>

	<p>number of staff available in the hospital, then the nursing administrator should call in staff to that patient needs can be met.</p> <p>When the number of disaster patients exceeds the number of available beds, the nursing staff should transport patients suitable for early discharge to the designated discharge holding area. The nursing staff should notify the admissions department of all early discharges.</p>
Operating rooms	<p>The anesthesiologist in charge should report to the HCG available ORs and staff. The anesthesiologist in charge should also cancel elective/non-emergent cases. If patient volume exceeds available staff, then the anesthesiologist in charge should call in additional personnel.</p> <p>Day surgical units should be the location for all disaster patients requiring minor operative care. In the event of a bioterror release, the number of patients who meet this category is likely to be small.</p>
PACU	<p>The PACU director should report PACU availability to the HCG. If necessary, additional staff should be called in. The anesthesiologist staffing the PACU should be responsible for making decisions regarding PACU matters. If a bioterror attack produces large numbers of intubated patients that overwhelm MICU capacity, the PACU should receive MICU overflow.</p>
Pathology	<p>Pathology should oversee transport from the ED to the morgue. The route of transport from the ED to the morgue should be predetermined. If additional morgue/refrigerator space is needed, the pathology staff should arrange and confirm with local hospitals and private suppliers additional refrigeration capacity.</p> <p>Pathology staff should be responsible for paperwork related to expirations, including identification, date and time of receipt, and the person receiving the body. All casualties of the bioterror disaster—either immediate or delayed—should be referred to the medical examiner. Pathology staff</p>

	<p>should remember to use contact precautions consistent with the type of bioterror attack.</p>
Radiology	<p>The chief radiologist should be notified of the disaster. A radiology attending should report to the ED along with a technologist to assist in the prioritization of studies needed by patients. In the event of airborne pathogen release, all plain films should be obtained portably in the ED. Although this approach may lead to suboptimal films, it limits exposure of the hospital and its staff to the bioterror agent. For other bioterror releases, only those patients requiring immediate studies or who are unstable for transport should receive portable studies.</p> <p>All inpatient and elective studies should be postponed until after the surge is cleared.</p>
Respiratory Care	<p>This department will oversee the administration of respiratory treatments. The respiratory therapist in charge will report to the ED and determine the type and amount of supplies needed. In the event of an airborne pathogen release, respiratory therapists will need to have adequate supplies of personal protective equipment to guard against infection. Furthermore, the number of respiratory therapists providing care in the ED should be limited, and those individuals should not return to the main hospital until cleared to do so.</p>
Department of Surgery	<p>All ongoing operations in the main operating rooms and day surgery units will be ended as expeditiously as possible. No other procedures should begin until cleared to do so. All surgical patients will be evaluated for discharge by the nurse in charge of surgical floors, in consultation with the surgical staff. The department of surgery should postpone all elective surgeries until the surge is cleared. Attending staff should remain in the operating rooms in anticipation of procedures, while chief residents report to the ED to assist in patient management.</p>

	The senior surgeon present determines when to call additional staff from home.
Support Department	<p>This department is responsible for the distribution of material to individual departments in the hospital. On notification of a surge of patients, normal paperwork requirements should be suspended. The support department should make available sufficient personnel to distribute supplies as directed by the Incident Commander.</p> <p>The support department should keep a 48-hour supply of all equipment sufficient for the average hospital census plus an additional 100 patients.</p>
Child Life Services/Social Work	Child life services should provide staff support for operations in the disaster discharge area. Child life activities should collaborate with nursing services in providing these services.
Labor Pool/Volunteer Services	A labor pool should be organized from the staff of departments and services not directly involved with the disaster. The labor pool should be located centrally in a mid-sized conference room such as the emergency department conference room. The labor pool should assist in transporting specimens to the laboratories, medical records pickup, transporting/escorting patients, delivering supplies, and delivering written messages to patient care areas.
Pharmacy	<p>The senior pharmacist on duty should assume responsibility for transitioning to emergency operations. The senior pharmacist should notify the Director of Pharmacy, call in additional staff if needed, and contact the physician in charge to offer services. The pharmacy department should maintain contact with other hospitals and local pharmacies for obtaining additional supplies. All pharmacy staff should remain on duty until the surge is cleared.</p> <p>The pharmacy should maintain a 48-hour supply of all pharmaceuticals for the average daily hospital census plus an additional 100 patients.</p>
Public Affairs	One person such as the director of public

	<p>affairs should report to the ED; this person should relay patient information to public affairs staff members at the main reception area of the hospital. Two public affairs staff persons should staff the main reception area of the hospital. One should receive patient names and conditions from the ED while the second should take media calls and respond to them. One staff member should be available to speak with members of the media, prepare a news conference, and assist in interviews. Public affairs staff should escort all members of the media within the hospital.</p>
Psychiatry	<p>Psychiatry services should be available during the disaster. Anticipated services include providing treatment to patients, families, and staff; advocating for the needs of patients, families, and staff; providing education to patients, families, staff, and the media regarding psychosocial effects of terror attacks; and providing consultation to schools to assist in coping with trauma.</p>
Environmental services	
Reception	<p>Personnel assigned to the main reception are should assist parents of victims in locating children; act as a liaison between Social Service, Public Affairs, and the ED; screen arriving visitors; and assist Security in managing traffic flow.</p>
Security	<p>A major responsibility of the security department should be to secure the emergency department against intrusion by unauthorized persons. Individual health care facilities must determine the level of personal protective equipment issued to security officers, as well as the level of force permissible to prevent unauthorized entry into the hospital. Securing the ED is vitally important to prevent contamination of the ED and to prevent the disruption of patient services.</p> <p>Security officers should be assigned to the triage area and the ED entrance. These officers are responsible for ensuring that only casualties, emergencies, and</p>

	<p>specifically authorized personnel enter the ED. Personnel assigned to this area should have a unique identifier such as self-adhesive “disaster dot” affixed to their hospital identification card.</p> <p>One security officer should be assigned outside the main ED entrance; this person will exert initial control of persons entering the ED, and will distribute disaster dots to authorized personnel. The following personnel should be authorized to enter the ED during a disaster surge: medical staff, physicians, critical care nurses, hospital administration members, members of the ECG, materials transporters bringing supplies, and specimen transporters.</p> <p>One security officer should be assigned to visitor and service elevators to restrict access to the hospital. An additional security officer should be assigned to ambulance bays to control access. All other available security officers should manage the traffic—both private and ambulance—arriving at the hospital.</p> <p>All other entrances to the hospital should be secured so that unauthorized entry—and contamination of the hospital—is impossible. Members of the media should not enter the hospital unless accompanied by a Public Affairs representative.</p>
Safety	<p>Members of the safety department should make appropriate measurements and observations to ensure the magnitude of risk of exposure to patients, employees, visitors, local community, and environment. In the event of an airborne hazard release, members of the safety department may be needed to assess air sampling and, if necessary, provide recommendations for temporary airflow barriers to ensure that the entire facility does not become contaminated.</p>
Telecommunications	<p>Once a disaster is declared, the telecommunications department should page all persons on the disaster notification</p>

	<p>list. After all necessary pages have been accomplished, the page operator notifies the supervisor on call who in turn notifies the telecommunications manager. The telecommunications department should direct all inquiries pertaining to the disaster to Public Affairs. Telecommunications staff should also be prepared to release information hospital staff who inquire about the level of personal protective equipment that is needed. No information should be given to the public by the telecommunications staff.</p>
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Figure 2.

JumpSTART Pediatric MCI Triage®

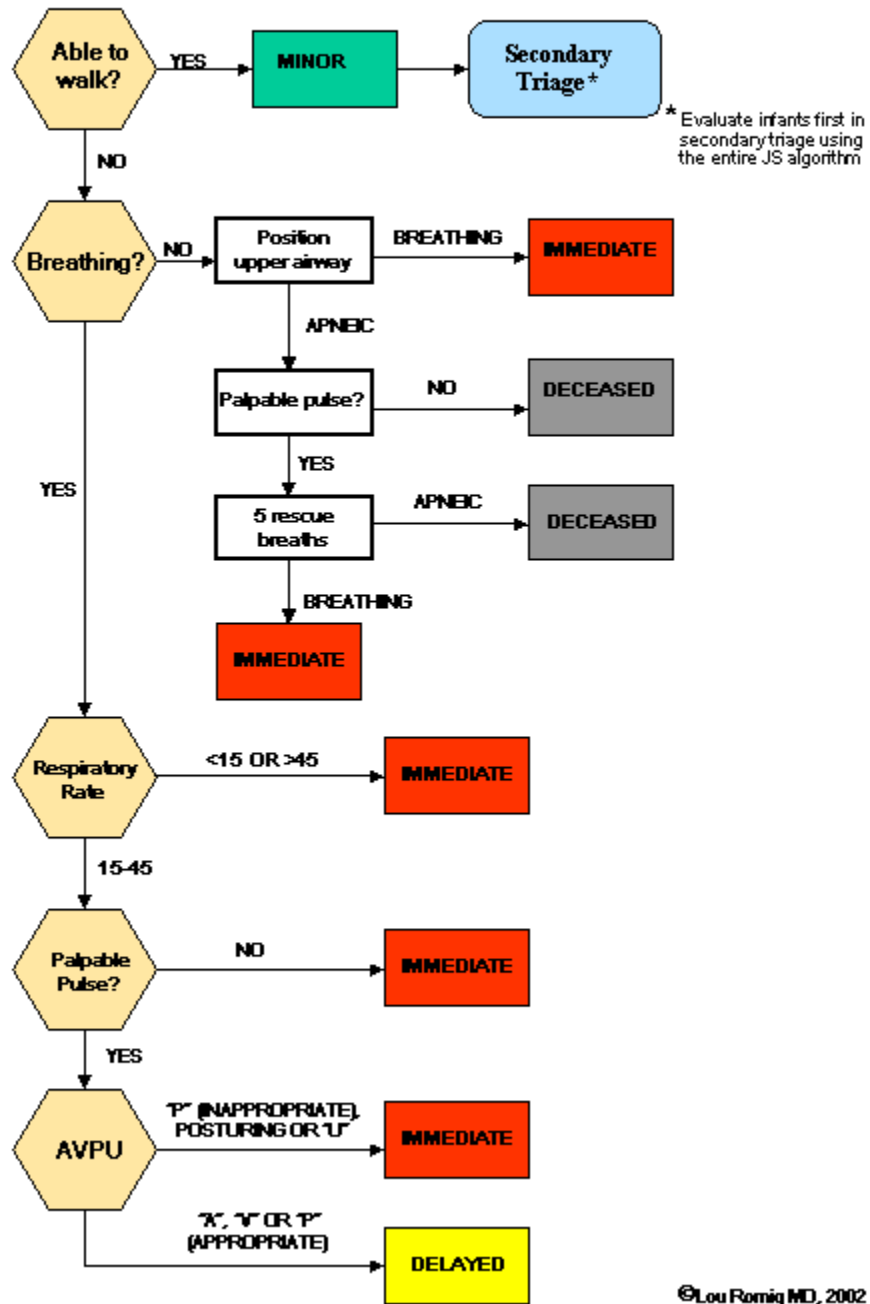
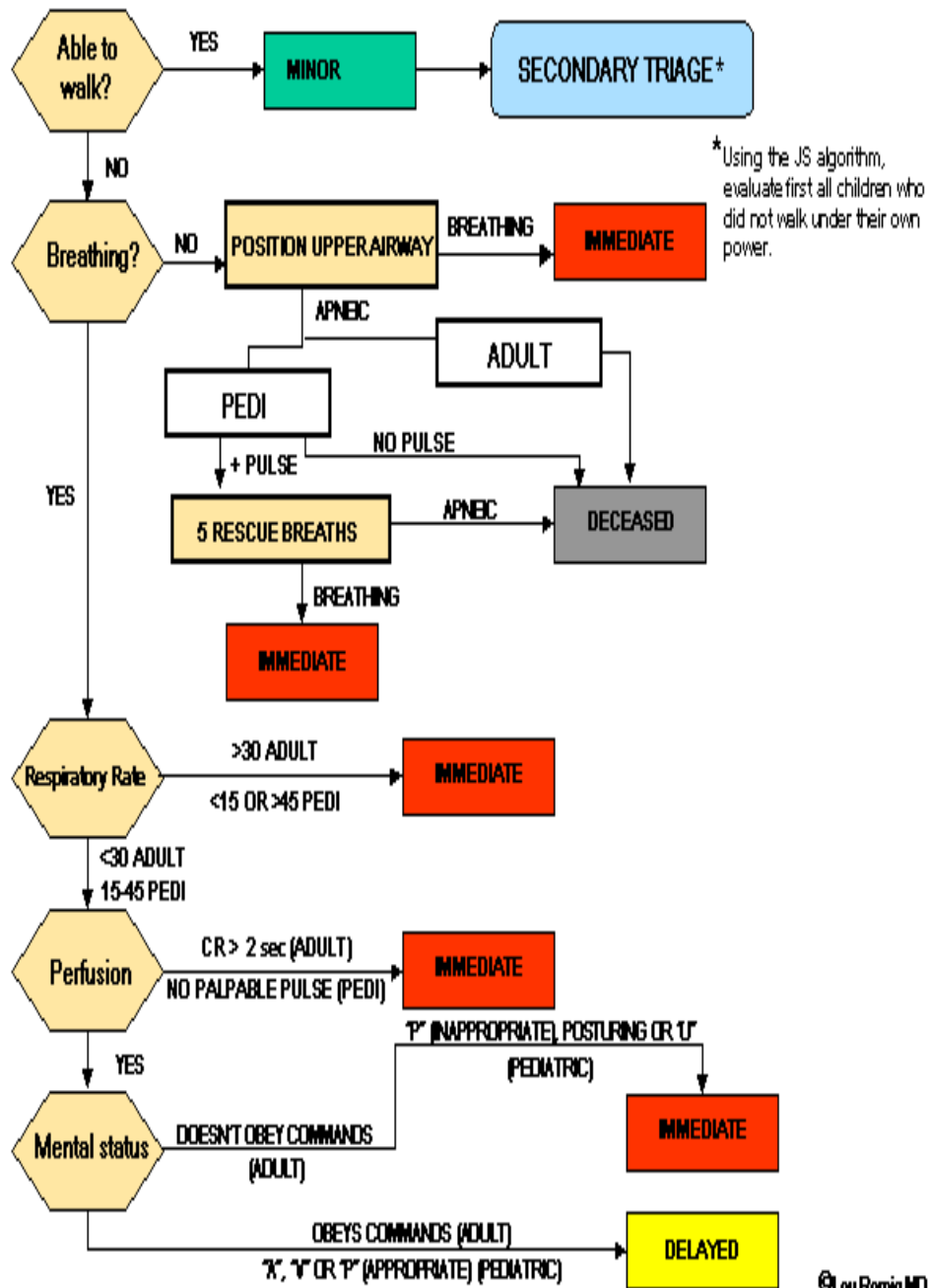


Figure 3.

Combined START/JumpSTART Triage Algorithm



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