



## Cardiopulmonary arrest emergencies in children

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### Abstract

When approaching a person who is suspected of experiencing breathing and/or heart arrest, we must first check the state of consciousness (asking to a question or slight shaking of the patient) and then we have check if the patient breathes and did he/she had the pulse. Cardiopulmonary resuscitation begins when the patient is unconscious, does not have pulse and does not breathe normally (ie if he/she is breathe less than 10/min.). It is important to note that pulse determination is sometimes very difficult, especially in people in hypothermia, and inexperienced people often push their own pulse instead of pulse of patient. Because of these aggravating circumstances, it is a good idea to start with the Cardiopulmonary resuscitation when the patient is unconscious, not breathing, or breathing agonally. Establishing a cardiorespiratory arrest should be started as soon as possible with basic life support measures, inviting professional help whose team will continue with the measures of advanced life care and care for the patients. Basic life support measures include providing passage of the respiratory tract, artificial breathing and heart massage. To an unconscious person we ensure the passage of the respiratory tract by throwing the head and raising the lower jaw, thus raising the base of the tongue that most often obstructs the respiratory tract of these persons. In children, the cardiovascular causes of this condition are far fewer (<15-20%), and in leading places are trauma, poisoning, various respiratory disturbances (eg respiratory tract obstruction, smoke inhalation, drowning, infections).

**Keywords:** child, cardiopulmonary arrest, signs, emergency

### Introduction

An emergency is commonly defined as any condition perceived by the prudent layperson—or someone on his or her behalf—as requiring immediate medical or surgical evaluation and treatment <sup>[1]</sup>. On the basis of this definition, the American College of Emergency Physicians states that the practice of emergency medicine has the primary mission of evaluating, managing, and providing treatment to these patients with unexpected injury and illness.

So what does an emergency physician (EP) do? He or she routinely provides care and makes medical treatment decisions based on real-time evaluation of a patient's history; physical findings; and many diagnostic studies, including multiple imaging modalities, laboratory tests, and electrocardiograms. The EP needs an amalgam of skills to treat a wide variety of injuries and illnesses, ranging from the diagnosis of an upper respiratory infection or dermatologic condition to resuscitation and stabilization of the multiple trauma patient. Furthermore, these physicians must be able to practice emergency medicine on patients of all ages. It has been said that EPs are masters and mistresses of negotiation, creativity, and disposition. Clinical emergency medicine may be practiced in emergency departments (EDs), both rural and urban; urgent care clinics; and other settings such as at mass gathering incidents, through emergency medical services (EMS), and in hazardous material and bioterrorism situations.

In healthcare delivery, we attempt to meet the health and medical needs of the community by providing a place for individuals to seek preventative medicine, care for chronic medical conditions, emergency medical treatment, and rehabilitation from injury or illness <sup>[2]</sup>. While a healthcare institution serves the community, this responsibility occurs at the level of the individual. Each individual expects a

thorough assessment and treatment if needed, regardless of the needs of others. This approach is different than that practiced by emergency managers, whose goal is to assist the largest number of people with the limited resources that are available. As such, emergency management principles are focused on the needs of the population rather than the individual. When either planning for a disaster or operating in a disaster response mode, the hospital should be prepared at some point to change its focus from the individual to the community it serves and to begin weighing the needs of any individual patient versus the most good for the most patients with scarce resources. Moving from the notion of doing the most for each individual to doing the best for the many is a critical shift in thinking for healthcare institutions considering a program of comprehensive emergency management. While the initial planning for emergencies by hospitals is focused on maintaining operations and handling the care needs of actual or potential increased numbers of patients and/or different presentations of illness or injury than is traditionally seen, there is also the need to recognize that at some point during a disaster, act of terrorism, or public health emergency there may be an imbalance of need versus available resources. At this point the approach to delivering healthcare will need to switch from a focus on the individual to a focus on the population. This paradigm shift is one of the core unique aspects of hospital emergency management that allows the hospital to prepare to maximize resources in disasters and then to know when to switch to a pure disaster mode of utilizing its limited and often scant resources to help the most people with the greatest chance of survival.

The healthcare delivery system is vast and comprised of multiple entry points at primary care providers, clinics, urgent care centers, hospitals, rehabilitation facilities, and

long-term care facilities. The point of entry for many individuals into the acute healthcare system is through the emergency department (ED). Since the late 1970s, the emergency medical services (EMS) system has allowed victims of acute illness and injury to receive initial stabilization of life-threatening medical conditions on the way to the emergency department. Among the many strengths of the ED is the ability to integrate two major components of the healthcare system: prehospital and definitive care. The emergency department maintains constant communications with the EMS system and serves as the direct point of entry for prehospital providers into the hospital or trauma center. Emergency physicians represent a critical link in this process by anticipating the resources that ill and injured patients will need upon arrival at the ED, and initiating appropriate life-saving medical care until specialty resources become available. In this context, the healthcare system is an emergency response entity.

### Patient Conditions

In most emergencies there is no time to disclose the necessary information for an informed consent [3]. Here the providers simply act according to what they think will be in the best interests of the patient. These situations frequently happen in hospital emergency rooms and when emergency medical personnel arrive on the scene of an accident or sudden illness.

The emergency exception to informed consent is often quite obvious, but this is not always so. It does not apply, for example, when personnel taking care of somebody in an emergency happen to know what the patient wants. In such a situation they would not do what they think is best for the patient but what they know the patient wants.

It is important to note that the emergency exception that allows physicians to do what they think is best for the patient without obtaining informed consent from the patient or proxy has one major restriction; namely, they cannot do what they think is best if it is otherwise than what they know the patient or proxy wants. Sometimes, for example, emergency department personnel might know from previous admissions that a particular patient from a local nursing home desires only palliative care. If that patient arrives by ambulance at the same emergency department, it is hard to see how it would be morally reasonable for physicians to take aggressive measures to keep the patient alive when, even though there is no time to obtain consent for orders not to attempt resuscitation or not to intubate, they know he or she or a proxy has decided not to have aggressive life-sustaining measures performed.

Patients accessing emergency care services can present with complaints that are extremely diverse, and the way doctors, nurses and paramedics elicit information from patients predominantly focusses on obtaining biomedical details [4]. In some cases, this approach is warranted, as the urgent need to identify signs and symptoms of life-threatening illness or injury is paramount. Yet, 90% of patients accessing emergency services are not critically ill or injured but seek help and advice. In addition to seeking advice, patients may also be anxious, frightened, intoxicated, misusing drugs or have unhealthy lifestyles. They may have psychosocial reaction to physical disease or vice versa – physical illness such as irritable bowel syndrome, asthma, tension headache can be triggered by psychosocial factors. The effects and interpretation of illness will trigger a different response to

the individual depending on their view and experiences. All these factors will have different needs and concerns and it is important to elicit these concerns within a consultation. However, it has been found that nurses working in emergency care disregard the potential for anxiety and the need for support and reassurance in patients who are not severely ill or injured. In addition, where communication skills of junior doctors working in emergency departments have been researched, they are found to use approaches considered to be more physician/illness orientated than patient-centred. By way of similarities of patient presentations in the pre-hospital setting, this could equally be assumed for paramedic practice.

### Cardiopulmonary Arrest

The outcome of cardiopulmonary arrest in children is generally poor, reaching a 90% mortality rate in some studies [5]. Most of these patients (87%) have an underlying disease. Respiratory arrest has been associated with a mortality rate of 33%, with most affected children being <1 year of age. Mortality is the same regardless of whether the arrest occurs in the prehospital or hospital setting. In adults, cardiac arrest usually is the result of underlying cardiac disease. In contrast, children usually develop cardiac arrest secondary to respiratory arrest and shock syndromes.

It is essential to recognize the sick or seriously ill child and understand the key differences between adults and children [6]. Knowing what is abnormal and identifying the sick child is impossible, unless the doctor is first able to recognize 'normal' paediatric developmental and physiological parameters. Early recognition and immediate management of potential respiratory, circulatory or neurological failure will reduce mortality and secondary morbidity.

Most emergencies generate fear in children causing additional distress to the child and adding to parental anxiety.

- Allow parents to stay with the child at all times.
- Use toys and picture books to placate the distressed infant.
- Explain things as clearly as possible to both the child and the parent.

### Childrens and Parents

Children do not always respond in the same way to illness as adults [7]. They are particularly likely to be frightened of doctors, nurses, and hospitals. Do not waste the opportunity to make important observations (respiratory rate, pattern, and effort, behaviour, conscious level, colour, and parental interaction). Spend time talking to children to reassure them and win their confidence before starting any examination or performing any procedure (unless, of course, they require emergency resuscitation). Lowering yourself to their physical level will make you less intimidating. Involve the parents from the start. Where appropriate, allow children to relax and play with toys. Play therapists can be particularly helpful providing distraction during procedures.

Parents are patients too. They are likely to be understandably upset and worried. Take time to explain to the parents exactly what is happening to their children at all stages. Obtain appropriate consent, but do not delay life-saving measures. For the sake of both parents and children, try to allow parents to remain with their children as much as possible. This is especially important during resuscitation where an experienced member of the nursing staff should be

allocated to look after and explain to parents what is happening. If the presence of the parents is impeding the progress of the resuscitation, gently ask them to leave.

### Approach

The emergency department (ED) is a challenging environment for patients, families, and medical personnel<sup>[8]</sup>. Many challenges result from our practice's principles: available at any time for any patient with any complaint. Patients who come to the ED are not familiar with us personally, yet must feel confident about our abilities to help them during their time of greatest concern. Their needs may be as straightforward as an excuse note for work or a prescription refill in the middle of the night, or as complex as an acute illness or injury, an exacerbation of a chronic condition, or a cry for help if depressed or suicidal. Even providing reassurance about a child's fever to a concerned parent is a critical function of emergency physicians (EPs). Qualities successful EPs exhibit include intelligence, sensitivity, humility, insight, proficiency making decisions with and acting on limited information, and the ability to multi-task. Being skillful negotiators, working well with individuals having different backgrounds and ethnicities, and advocating strongly for patients at all times are essential qualities. In addition to these traits, EPs must be experts in trauma and medical resuscitation of adults and children, and in sharing news with patients and family members about the outcomes of these events.

The majority of patients use the ED infrequently. Many may be experiencing this setting for the first time. Patients' lack of familiarity with this environment, fear, stress, waiting times, painful procedures, and overall discomfort often preclude them from having a positive experience. These are only some of the issues that patients contend with in the ED. EPs confront numerous challenges when taking care of patients presenting to the ED. Perhaps the greatest challenge is the spectrum of diseases which EPs must be able to identify. Rather than having to know only the first 15 minutes of an illness, EPs must be familiar with all stages of all illnesses, often presenting in atypical fashion. In addition, time pressures inherent to providing emergency care, the lack of existing relationships with patients, unfamiliarity with their medical history, and the inability to review patients' medical records challenge EPs daily. EPs must rapidly and simultaneously evaluate, diagnose and treat multiple patients with multiple conditions, often with limited information, without confusing subtle nuances between patients. They must be insightful, anticipatory, and prepared to act and react to prevent morbidity and, when possible, mortality. Considering worse case scenarios is fundamental to EM practice. Most importantly, EPs must be comfortable providing detailed, often devastating information in a concise yet understandable manner to patients and family members who may have different cultural backgrounds.

It is indeed a privilege to be in a position to offer care to patients during what is likely to be their time of greatest need. Approaching patients sensitively, recognizing their apprehension, pain, concerns, and perhaps shame is critical to our mission. This is true no matter how trivial a patient's problem may seem. Often, patients consult with EPs to seek approval about their desire to leave a spouse, to get an opinion regarding a physician's recommendation for surgery, or to receive confirmation that they are making the

right decision about a parent, child, or loved one. Serving in this capacity, without judgment, is not only appropriate but also essential.

### Signs

Signs of respiratory failure can be recognized but may be quite subtle initially<sup>[5]</sup>. These include noting abnormal respirations that are characterized by tachypnea, bradypnea, apnea, or increased work of breathing. Cardiac function decompensation then leads to a shock state that is associated with impaired cardiac output. This is usually manifested by tachypnea, hypotension, and poor peripheral circulation. As cardiac functions worsens, impaired perfusion causes delayed capillary refill time (>2 seconds), mottling, cyanosis, cool skin, altered level of consciousness, poor muscle tone and finally decreased urine output. The most common rhythm seen in pediatric arrest situations is bradycardia leading to asystole. By recognizing this typical pattern, the emergency physician can intervene and potentially prevent full cardiopulmonary arrest. The precipitating causes of cardiopulmonary arrest are many, and often these can be identified and prevented.

### Emergencies

Because the needs of children will vary from those of adult patients, a technical specialist specific to the needs of children (pediatrician, child psychologist, etc.) will likely be needed during all disasters<sup>[9]</sup>. Specialized medical knowledge specific to pediatric exposure to chemical, biological, or radiological materials will be beneficial to the incident commander (IC) or the CMO (Chief Medical Officer) advising the IC. Additional guidance that can be provided relates to the social service issues of reconnecting children who have been separated from their parents because of the disaster. In dealing with neonatal issues, staff with expertise in this area will need to be recruited to manage this very specific subpopulation of patients. The care of pediatric patients will need to be in a designated area that has equipment and supplies that are specific to pediatric patients.

Evaluation of cardiopulmonary function in children, especially in infants and younger children, requires special techniques<sup>[10]</sup>. Vital signs are generally insensitive and nonspecific. Blood pressure poorly reflects volume status. In children, hypovolemia triggers compensatory tachycardia and intense peripheral vasoconstriction, which effectively maintains blood pressure until volume loss exceeds about 50% of intravascular volume.

Tachycardia, while sensitive to cardiopulmonary duress, is nonspecific. Normal heart rate also varies with age, and tachycardia is a common response to many types of stress (eg, fever, anxiety, hypoxia, hypovolemia). In children, assessment of volume status should focus primarily on skin signs (temperature, color, capillary refill, turgor) in combination with heart rate. Rate of urine output may be the next best measure of core perfusion. Adequate core blood flow results in 1–2 mL/kg/h of urine production. Therefore, in the unstable child with suspected perfusion abnormalities, a urinary bladder catheter is imperative to monitor output. Also, close monitoring of mental status and interaction with the surrounding environment is important indicators of adequate cardiopulmonary perfusion.

Cardiac rhythm disturbances in children are unusual. The most common disturbance is bradycardia, usually secondary

to hypoxia. Properly applied pulse oximetry, at the triage desk or part of an initial clinical assessment, is an easy and useful method for rapid evaluation of oxygen saturation in patients with slow or rapid heart rates. When a primary tachycardia occurs, it is usually supraventricular in origin. In the distressed child, ECG monitoring will assist in evaluating cardiovascular status and in judging response to therapy.

### Management

Pediatric cardiopulmonary resuscitation (CPR) differs from CPR in the adult <sup>[11]</sup>. Primary cardiac arrest is rare in children. Rather, there is a respiratory arrest that leads to hypoxemia and acidosis, and culminates in a bradycardic or asystolic arrest. Inevitably, by the time asystole occurs, severe damage to the brain, kidney, and gastrointestinal tract has occurred. Survival in children from a cardiac arrest is dismal, and most who do survive have significant neurological impairment.

Pediatric cardiopulmonary resuscitation is best when performed by a coordinated team of physicians, nurses, respiratory therapists, and other support personnel <sup>[5]</sup>. Children must be carefully monitored with frequent vital sign assessment, cardiac monitoring, and pulse oximetry. Fluid calculations need to be made based on an estimated weight based on age, a measured weight, or measured length using a resuscitation tape (e.g., Broselow tape). The key to any pediatric resuscitative effort is adequate and timely airway management. Careful attention must be given to positioning the infant or young child as the prominent occiput can cause neck flexion and airway occlusion. Mild extension of the head to the “sniffing” position will most often provide a patent airway. Avoid over-extension as this may cause airway obstruction by compressing the flexible trachea. Avoidance of neck movement with in-line stabilization must be done if there is any suspicion of neck trauma. In an unconscious patient, hypotonia may result with the tongue falling against the posterior pharyngeal wall. The chin lift and jaw thrust maneuver will open the airway in this case. Once the airway has been opened manually, nasopharyngeal tubes for conscious children or oropharyngeal airways for unconscious children may be beneficial.

### Disposition

Preliminary evidence has shown that if cardiac muscle is not responsive to the first three doses of epinephrine when adequate oxygenation and ventilation have been supplied, then there is no hope for survival <sup>[5]</sup>. Additional research is needed to confirm this, particularly in children. Efforts should be terminated if there is obvious brain death. Resuscitation should be continued if there is evidence of drug depression or hypothermia. Those children surviving resuscitation should be admitted to a pediatric intensive care unit. Resuscitation of an infant or young child is an emotionally stressful event that can leave an indelible impression on the mind and emotions of health care providers. Consequently, organization and an understanding and preparation for pediatric resuscitation should be a high priority for Emergency Departments.

### Responsibility of the Physicians

The aim is to provide excellence in emergency department (ED) care by cultivating the following desirable habits <sup>[12]</sup>:

- Listen to the patient.
- Exclude the differential diagnoses (‘rule out’) and refine the possible diagnosis (‘rule in’) when assessing any patient, starting with potentially the most life-or limb-threatening conditions, and never trivializing.
- Seek advice and avoid getting out of depth by asking for help.
- Treat all patients with dignity and compassion.
- Make sure the patient and relatives know at all times what is happening and why, and what any apparent waits are for.
- Maintain a collective sense of teamwork, by considering all ED colleagues as equals whether medical, nursing, allied health, administrative or support services.
- Consistently make exemplary ED medical records (see below).
- Communicate whenever possible with the general practitioner (GP).
- Know how to break bad news with empathy.
- Adopt effective risk management techniques.

The duty of care is a physician’s obligation to provide treatment according to an accepted standard of care <sup>[13]</sup>. This obligation usually exists in the context of a physician–patient relationship but can extend beyond it in some circumstances. The physician–patient relationship clearly arises when a patient requests treatment and the physician agrees to provide it. However, creation of this relationship does not necessarily require mutual assent. An unconscious patient presenting to the ED is presumed to request care and the physician assessing such a patient is bound by a duty of care. The Emergency Medical Treatment and Active Labor Act (EMTALA) requires ED physicians to assess and stabilize patients coming to the ED before transferring or discharging them. Such an assessment presumably creates the requisite physician–patient relationship.

When caring for a patient, a physician is obligated to provide treatment with the knowledge, skill, and care ordinarily used by reasonably well-qualified physicians practicing in similar circumstances. In some jurisdictions, these similar circumstances include the peculiarities of the locality in which the physician practices. This locality rule was developed to protect the rural practitioner who was sometimes deemed to have less access to the amenities of urban practices or education centers. However, the locality rule is being replaced by a national standard of care in recognition of improved information exchange, ease of transportation, and the more widespread use of sophisticated equipment and technology.

Establishing the standard of care in a given case requires the testimony of medical experts in most circumstances, unless the breach alleged is sufficiently egregious to be self-evident to the lay jury member—for example, amputating the wrong limb or leaving surgical implements in the operative field. A physician specializing in a given field will be held to the standard of other specialists in the same field, rather than to the standard of nonspecialists.

To be eligible to receive federal funds such as Medicare and Medicaid, hospitals with an emergency department must offer emergency and stabilizing treatment services to the public without bias or discrimination <sup>[14]</sup>. The Emergency Medical Treatment and Active Labor Act is a comprehensive federal law that obligates hospitals offering

emergency services to do so without consideration of a patient's ability to pay. It's important to note that this obligation does not apply to inpatients or non-emergent conditions. The absence of bias in the delivery of care should not be misunderstood to suggest all hospitals must provide all medical services, but rather the services they choose to offer must be delivered without bias to the individual patient.

A hospital and its entire staff owe a duty of care to patients admitted for treatment [15]. Following an emergency call, the ambulance service has a duty to respond and provide care. Accident & Emergency (A&E) departments have a duty of care to treat anyone who present themselves and are liable for negligence if they send them away untreated. Hospitals without an A&E facility will display signs stating the location of the nearest A&E department. This ensures that the hospital could not be held negligent if a patient presented and required emergency treatment as the hospital or its staff had never assumed a duty of care. Once a patient is handed over, a duty of care is created between the patient and the practitioner and this cannot be terminated unless the patient no longer requires the care or the carer is replaced by another equally qualified, competent person. It is therefore extremely important that practitioners are aware of their local policies, professional standards and their scope of practice to avoid becoming liable for litigation by putting a patient at risk, delivering ineffective care or breaching their duty of care.

### Conclusion

Cardiopulmonary resuscitation is a combination of resuscitation measures taken to re-establish heart and breathing function for a patient who has experienced breathing arrest and/or heart arrest. The main goal of reanimation is to provide sufficient oxygen to the brain, heart, and other vital organs, as long as the more complex procedures of cardiopulmonary resuscitation do not establish adequate cardiac action and spontaneous breathing. Despite the implementation of cardiopulmonary resuscitation, mortality in infants and young children ranges between 80 and 97%. The mortality of an isolated respiratory tract goes up to 25%, and the neurological outcome is often very disadvantageous. About 50-65% of children who need cardiopulmonary resuscitation are younger than one year, and most do not have 6 months. About 6% of newborns need resuscitation at birth, and this frequency increases steeply if the birth weight <1500g. Newborns, infants and young children at hypoxia develop bradycardia earlier, while older children are more prone to initial tachycardia. Infant or small child with a rhythm of <60/min, which do not respond to assisted breathing, should start with a heart massage. Bradycardia can come within the heart block, although it is rare at that age.

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