

# **Pediatric Emergencies**

**EMS Continuing Education  
EMR through ACP**

**Consistent with the  
National Occupational Competency Profiles  
as developed by  
Paramedic Association of Canada  
and  
“An Alternate Route to Maintenance of Licensure”  
as developed by Manitoba Health**

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## **Disclaimer**

These documents were developed for improved accessibility to standardized continuing education for all paramedics in Manitoba.

This training package is consistent with the National Occupational Competency Profiles and the core competency requirements (both mandatory and optional) as identified in “An Alternative Route to Maintenance of Licensure” (ARML). It is not the intent that this package be used as a stand-alone teaching tool. It is understood that the user has prior learning in this subject area, and that this document is strictly for supplemental continuing medical education. To this end, the Paramedic Association of Manitoba assumes no responsibility for the completeness of information contained within this package.

It is neither the intent of this package to supersede local or provincial protocols, nor to assume responsibility for patient care issues pertaining to the information found herein. Always follow local or provincial guidelines in the care and treatment of any patient.

This package can be used in conjunction with accepted models for education delivery and assessment as outlined in “An Alternative Route to Maintenance of Licensure”. Any individual paramedics wishing to use these continuing education packages to augment their ARML program should contact their local EMS Director.

This document was designed to encompass all licensed training levels in the province (Technician, Technician – Paramedic, Technician – Advanced Paramedic.). Paramedics are encouraged to read beyond their training levels. However, it is suggested that the accompanying written test only be administered at the paramedic’s current level of practice.

This package has been reviewed by the Paramedic Association of Manitoba’s Educational Subcommittee and is subject to review by physician(s) or expert(s) in the field for content.

As the industry of EMS is as dynamic as individual patient care, the profession is constantly evolving to deliver enhanced patient care through education and standards. The Paramedic Association of Manitoba would like to thank those practitioners instrumental in the creation, distribution, and maintenance of these packages. Through your efforts, our patient care improves.

This document will be amended in as timely a manner as possible to reflect changes to the National Occupational Competency Profiles, provincial protocols/Emergency Treatment Guidelines, or the Cognitive Elements outlined in the Alternate Route document.

Any comments, suggestions, errors, omissions, or questions regarding this document may be referred to [info@paramedicsofmanitoba.ca](mailto:info@paramedicsofmanitoba.ca) , attention Director of Education and Standards.

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## ***Introduction***

Dealing with a pediatric emergency is one of the most stressful calls a medic can encounter. Children are not “little adults”. Their anatomy and physiology deserve special consideration since it differs from an adult. From an emotional standpoint, children are also unique. Their reactions and capabilities differ depending on their developmental stage and life experience.

### **Conventions Used in this Manual**

Black lettering without a border is used to denote information to the EMR Level and above.

Text with single striped border on the left is information appropriate to EMT Level I (B)/Primary Care Paramedic and above. The required cognitive elements to be covered within this module are the same for the EMT I (B), Primary Care Paramedic, EMT II (I), Advanced Care Paramedic, EMT Level III (P) and Critical Care Paramedic. Therefore there will only be the 2 conventions used throughout this manual.



## ***Developmental Stages - A Key to Assessment***

Certain general principles apply in dealing with children of any age who are sick and/or injured. You should:

- be calm, patient and gentle
- be honest. Do not tell the patient it will not hurt if it will hurt
- try not to separate the child from his parents (an exception to this would be where child abuse is suspected)

However when life-threatening illness or injury occurs in a child of any age, conduct the primary survey rapidly without taking time for preliminaries, and manage life-threatening conditions. When illness or injury allows more time for assessment, however, certain techniques make it easier to work with children.

### **Infants - under 6 months old**

- likely not to mind being totally undressed for assessment
- conduct detailed assessment (secondary) in “toe-to-head” order (most small children do not like having their faces touched by strangers)
- attempt to keep infant close to parent
- respond to facial expressions

### **Infants-6-12 months old**

- will tolerate being undressed, however, keep patient very close to parent
- conduct “toe-to-head” assessment
- talk and coo to patient during surveys

### **Toddlers-1-3 years old**

- do not want to talk to strangers or be undressed by them
- very frightened
- prioritize the areas that need immediate assessment and complete them ASAP
- do not shout at patient, remain very calm

### **Pre-schooler-4-5 years old**

- usually cooperative unless extremely frightened
- these children enjoy “helping out” and generally there is no problem with completing standard head-to-toe survey
- maintain good eye contact and gentle firmness
- able to understand simple directions

### **School-age child-6-12 years old**

- likely cooperative
- appreciate being treated with respect and like an explanation of what's being done

### **Adolescent-13-18 years old**

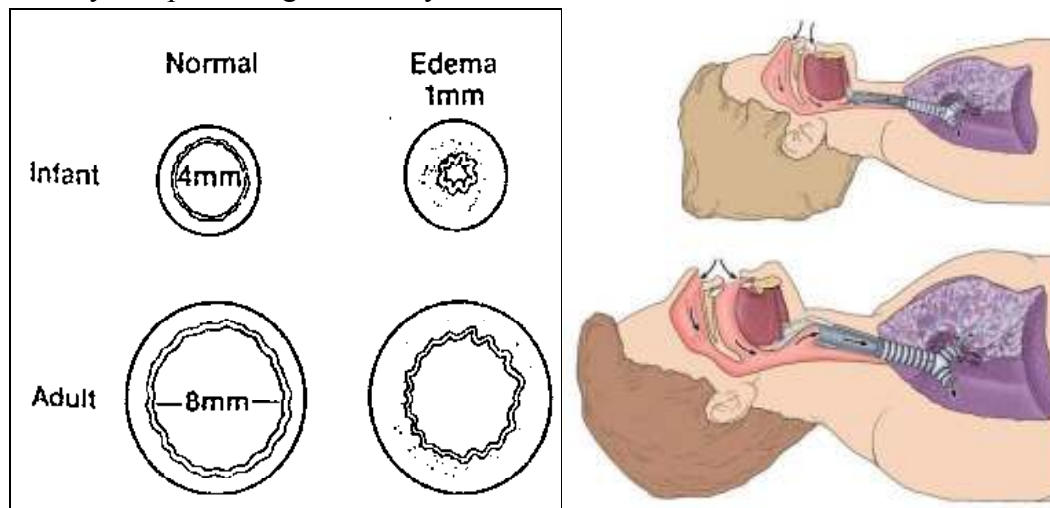
- unusually concerned about his/her bodily integrity and requires constant reassurance following completion of each survey segment
- examine the same way as an adult
- quite concerned with having their privacy protected

## ***Anatomy and Physiology***

### **Airway**

The pediatric airway is smaller in diameter (narrower) and less rigid than the adult airway. Small amounts of blood, mucus, or edema have a profound effect on airway diameter which leads to increased resistance and respiratory distress. Airway obstruction can come from a variety of sources including croup (airway edema), foreign bodies and the tongue, which is relatively large compared to an adults.

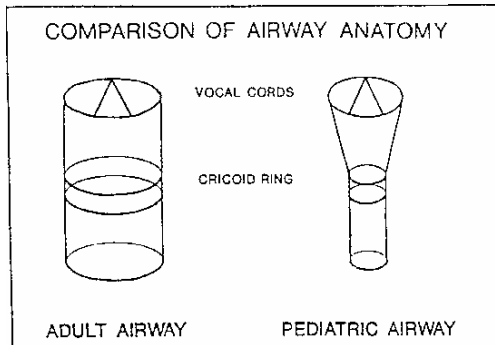
Opening a pediatric airway is affected by the soft, cartilaginous larynx. Using hyperextension, as in an adult, to open an airway can cause kinking of the larynx and subsequent occlusion of the airway. It is difficult to properly position an infant's airway due to the large head which naturally, in the supine position, forces the chin into the chest thereby compromising the airway.



*Figure Small changes in the diameter of the infant's airway can have a great effect on air flow.*

*Anatomy of a child's airway differs from that of an adult's in five principal ways: back of the head is larger in a child, so head positioning requires more care. The tongue is proportionally larger and more anterior in the mouth. The epiglottis is larger. The trachea is smaller in diameter and more flexible. The airway itself is lower and narrower. Cricoid cartilage is the narrowest portion of the airway as versus the larynx in an adult.*

Unless the child is a victim of trauma, the head tilt chin lift method should be used to open the airway and the head should be in sniffing position (applies to infants birth to 1 year of age). Oral airways can be used to maintain a patent airway. You must be careful, however, to choose the appropriate size, since one that is too large (or small) may displace the tongue back into the pharynx or directly block the airway.



*The narrowest portion of the child's airway is at the cricoid ring, whereas the adults it is at the vocal cords.*

Suction is often required to achieve airway patency. The suction device is inserted to the posterior pharynx then suction is applied by occluding the opening of the catheter, while withdrawing the catheter with a rotating, twisting motion. Suction should not exceed 5-10 seconds and is preceded and followed by ventilation with 100% oxygen to avoid hypoxia. Remember, oxygen is removed as well as secretions during suctioning. The safe amount of suction varies with age:

Premature to Low Birth Weight	60-80 mm Hg
Term Infants	80-100 mm Hg
Children	100-120 mm Hg
Adolescent	110-150 mm Hg

Vagal stimulation, resulting in bradycardia, may occur from catheter stimulation, therefore heart rate should be monitored.

Infants (3-5 months old) are obligate nose breathers. This allows them to feed and breathe simultaneously. At this young age, infants have not learned to mouth breathe, therefore blockage of the nasal passages can cause significant respiratory distress. Vigorous crying or suctioning of the nares, however, can often resolve this problem providing no serious underlying condition is present.

## **Breathing**

Infants and children have a relatively thin chest wall. This can make auscultation for decreased or absent breath sounds difficult because sounds are easily transmitted. The ribs and sternum normally support the lung and help it remain expanded. The intercostal muscles and diaphragm function to alter intrathoracic pressure and volume resulting in air exchange. Since a child's intercostal muscles are poorly developed, they contribute very

little to chest wall movement during inspiration. Children, therefore, use their diaphragm as the major muscle for respiration and require full diaphragmatic excursion to breathe. Because they rely more on diaphragmatic breathing than adults, anything that restricts diaphragmatic function such as:

1. pressure from above (pulmonary hyperinflation - asthma) or
2. pressure from below (gastric distention)

can lead to significant respiratory compromise. Distention impedes ventilatory efforts because the chest wall cannot compensate by expansion. During times of respiratory distress, the combination of diaphragmatic breathing and pliable ribs allows the chest wall to move in (retract) during inspiration instead of moving out.

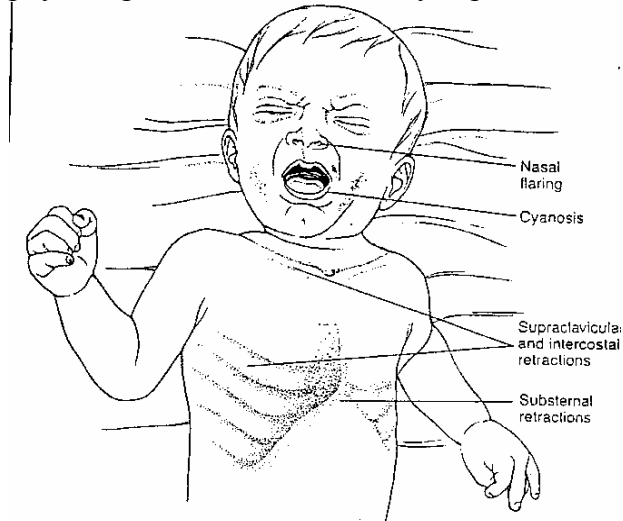
Children have smaller tidal volumes with smaller and fewer alveoli than adults. Too much volume when ventilating can cause a pneumothorax. However, due to the infants less compliant lungs, coupled with the tendency of the terminal airways to collapse during respiratory distress, a slightly increased pressure may be required to achieve ventilation.

When a pediatric patient is distressed, further compromise occurs due to the increased oxygen demand required to maintain the increased work of breathing. Hypoxemia in children may also be aggravated by a high metabolic rate that is about twice that of an adult. This increased demand, combined with the fact that the infant has fewer alveoli and less physiologic reserve, can lead to a mismatch between oxygen supply and demand. When children need to work to breathe, they experience respiratory fatigue more rapidly than adults. This results in sudden decompensation. Thus supplemental oxygen is always a priority when a child experiences respiratory distress.

Signs of respiratory distress in children include:

- tachypnea
- increased respiratory effort
- retractions
- nasal flaring
- head bobbing
- grunting
- stridor or wheezing
- weak cry
- depressed level of consciousness
- irritable
- lethargic
- Tracheal tug
- decreased responsiveness (especially to parents)
- Late signs:
  - bradycardia
  - decreased air movement
  - weak muscle tone, flaccid, not struggling
  - apnea, gasping, cyanosis

Late signs of respiratory distress are indicative of a potential arrest. Initially children can compensate quite well for illness due to their healthy cardiovascular system. The obvious signs of serious illnesses, such as changes in mental status and vital signs, are often subtle in the child and may be complicated by the child's fear and anxiety. It is imperative to recognize early signs of distress since once cardiorespiratory arrest occurs, the child's physiologic reserves are severely depleted and their prognosis is poor.



*Figure 3. Nasal flaring and retractions are signs of significant respiratory distress in pediatrics.*

### **Circulation**

Infants and young children have a larger surface area in relation to their height and weight plus a higher metabolic rate than adults. These factors predispose the child toward rapid heat loss, greater insensible water losses and hypoglycemia during times of stress. Central heat regulating centers are not well developed so children develop fevers or hypothermia easily. Fever and diaphoresis contribute to insensible water losses and if coupled with sensible fluid losses, such as vomiting and diarrhea, can lead to dehydration. An infant's high glucose needs, yet small glycogen stores, can rapidly lead to hypoglycemia.

Although the infant has a higher per kilogram blood volume than an adult, the absolute blood volume is less. Therefore, relatively small amounts of blood loss can be significant in a child. A child can compensate effectively for blood loss, thus there may be no change in blood pressure until 25% of the blood volume is lost.

Infants have smaller stroke volume (SV) than adults, thus increasing heart rate is the infant's primary method of increasing cardiac output ( $CO = SV \times HR$ ). As age increases, stroke volume increases and heart rates drop. Infants can maintain heart rates higher than adults without difficulty. However, once heart rate exceeds 180-200 bpm, diastolic filling time is compromised and cardiac output is decreased. Infants and children adequately maintain blood pressure by compensating for volume loss through:

- vasoconstriction
- tachycardia
- Hypotension only develops after the cardiovascular reserve is depleted.

Bradycardia causes a significant drop in cardiac output because of an infant's relatively small stroke volume. Bradycardia is defined as:

- <100 in neonates
- <60-80 in a child

Although tachycardia is an early sign of both shock and respiratory distress, it is not the most reliable indicator of impending problems because many other factors can cause tachycardia (fear, anxiety, fever). Bradycardia, however, is a very ominous sign as it readily leads to hypoxia and hypotension. Indicators of volume depletion, aside from tachycardia, include:

- strength of peripheral pulses (weak)
- capillary refill (slow)
- lack of tearing
- moistness of mucous membranes (decreased)
- condition of the fontanelle (sunken)
- history of urine output (decreased)
- tenting of skin (ie decreased rebound after retraction)
- sunken eyes (extreme ie. >10% dehydration)
- cool peripheries

Obtaining blood pressures on children is often difficult as they will not remain still or the proper size cuff is not available. A cuff should cover 2/3 of the upper arm. Keep in mind that a cuff that is too big will provide a lower reading while too small a cuff will produce a higher reading.

**Table I Modified Glasgow Coma Scale for Infants**

<b>Activity</b>	<b>Best Response</b>	<b>Score</b>
Eye Opening	Spontaneous	4
	To speech	3
	To pain	2
	None	1
Verbal	Coos, babbles	5
	Irritable, cries	4
	Cries to pain	3
	Moans to pain	2
	None	1
Motor	Normal spontaneous	6
	Withdraws to touch	5
	Withdraws to pain	4
	Abnormal flexion	3
	Abnormal extension	2
	None	1

## **Musculoskeletal**

A child's bones have not finished growing; they are more flexible and elastic than those in an adult's skeleton. Fat is distributed in a child in a somewhat different way than in an adult, so vital organs in the abdomen and the chest of a child are less well insulated. Therefore, a child may experience significant injuries to internal organs but have little or no evidence of external trauma. This is especially true of chest injuries. Because a child's ribs are softer and more flexible than those of an adult, they may compress the underlying lungs and heart, causing life-threatening conditions without obvious external damage.



### ***General Approach To Pediatric Assessment***

Priorities in management of the pediatric patient, as with all patients are established on a threat-to-life basis. However, if life-threatening problems are not present, the following general approach is recommended.

#### **History**

Questions for the child should be specific and direct. Keep in mind the developmental stages described previously. You should focus on the observed behavior, as well as on what the child or parent says. Visual assessment is very important. Approach the child slowly and gently to encourage cooperation and to gain confidence. The approach should be kind, yet firm. The child should not be separated from the parent unnecessarily. Get down to the same visual level as the child. Remember, if the child violates a parental rule, he or she may distort the facts. In addition, children may imagine fantasy as reality and reality as fantasy. Always be honest with the patient. Never tell the child that it "won't hurt" if you know it will. Instead say "This might hurt a little bit, and you can cry if you want to." Children respond to calm reassurance. Converse with the patient in a soft voice, using simple words.

#### **Physical Examination**

After the pertinent patient history has been obtained, attention should be turned toward the physical examination. Avoid touching any injured or painful areas until the child's confidence has been gained. Begin your examination without instruments. If possible, allow the child to determine the order of the examination.

The physical examination of the child should be systematic and should follow the same format used for adults. In the infant, special attention should be paid to the anterior fontanelle. The **fontanelles** are areas of the skull that have not yet fused. They allow for compression of the head during childbirth and for rapid growth of the brain during early life. The posterior fontanelle is generally closed by 4 months of age. The anterior

fontanelle diminishes after 6 months of age and is generally closed by 9-18 months of age.

The anterior fontanelle should be inspected in all infants. Normally, it should be level with the surface of the skull, or slightly sunken, and it may pulsate. With increased intracranial pressure, such as occurs with meningitis or head trauma, the fontanelle may become tight and bulging. Pulsations may diminish or disappear. With dehydration, the anterior fontanelle may often fall below the level of the skull and appear sunken.

Gastrointestinal disturbances are common in children and can occur with virtually any disorder. When confronted with a child who has been vomiting, it is important to determine how many times the child has vomited, the color of the vomitus, and other associated symptoms. The same procedure holds true for diarrhea.

### **Pediatric Vital Signs**

Poorly-taken vital signs in the pediatric patient are of less value than no vital signs at all. The following general guidelines will help you obtain accurate pediatric vital signs.

- Take vital signs with the patient in as close to a resting state as possible. If necessary, allow the child to calm down before attempting vital signs. Vital signs in the field should include pulse, respirations, blood pressure, and, if equipment available, temperature.
- Obtain blood pressure with an appropriate-sized cuff. The cuff should be two-thirds the width of the upper arm.
- Determine the pulse at the brachial artery, carotid artery, or wrist, depending upon the size of the child. There is often a significant variation in the pulse rate in children due to respirations. Therefore, it is important to monitor the pulse for at least 30 seconds, a full minute if possible.
- It is generally not possible to weigh the child. However, if medications are required, make a good estimate of the child's weight. Often the parents can provide a fairly reliable weight from a recent visit to the doctor.

## Normal Pediatric Vital Signs by Age

Group	Age	Respiratory rate		Pulse rate		Blood pressure	
		breaths per minute	assume problem exists*	beats per minute	assume problem exists*	expected	assume problem exists*
newborn	0-6 weeks	30-50	<30 or >50	120-160	<100 or >150	75-100 / 50-68	<70
infant	7-52 weeks	20-30	<20 or >30	80-140	<80 or >120	84-106 / 56-70	<70
toddler	1-2 years	20-30	<20 or >30	80-130	<60 or >110	98-106 / 50-70	<70
preschool	2-6 years	20-30	<20 or >30	80-120	<60 or >110	98-112 / 64-70	<70
school age	6-13 years	(12-20) – 30	<20 or >30	(60-80) – 100	<60 or >110	104-124 / 64-80	<80-90
adolescent	13-16	12-20	<12 or >20	60-100	<60 or >100	118-132 / 70-82	<80-90

\*assume a problem exists if vital sign falls within these parameters

- Observe respiratory rate before beginning the examination. After the examination is started, the child will often begin to cry. It will then be impossible to determine respiratory rate. For an estimate of upper limit of respiratory rate, subtract the child's age from 40. It is also important to identify respiratory pattern, as well as retractions, nasal flaring, or paradoxical chest motion.
- Observe the child for level of consciousness. There may be a wide variability in levels of consciousness and activity.

### **Non-Invasive Monitoring**

Electronic monitoring devices are becoming commonplace in modern pre-hospital care. Pulse oximeters, ECG monitors, and automated blood pressure devices all have application in pediatric emergency care.

Pulse oximetry is particularly useful in pediatric care as many pediatric emergencies are due to respiratory problems. The pulse oximeter gives you immediate information regarding peripheral oxygen saturation. In addition, it allows you to follow trends in the patient's pulse rate and oxygenation status.

Any critically ill or injured child should receive continuous ECG monitoring. This will provide essential information regarding the patient's heart rate. It will also help you to monitor the effects of any medications administered.

Monitoring devices may frighten the child. Before applying any monitoring device, explain to the child what you are going to do. Show him or her the display or lights. If the monitoring device makes noise, allow the child to hear the noise before you apply it. Reassure the child that the device will not hurt him or her.

## ***Pediatric Trauma Emergencies***

Trauma is the leading cause of death in children. The most common mechanism of injury is motor vehicle accidents, followed by burns, drowning, falls, and firearms. Most pediatric injuries result from blunt trauma. However, if you serve in an urban area, you can expect to see an increasing incidence of penetrating trauma in children. The most common body area injured in pediatric multiple trauma victims are the head, trunk, and extremities. Your approach to pediatric trauma is much the same as for adult trauma victims. You should first complete the A-B-C-D-E steps of initial assessment (primary). These include:

- Airway with cervical spine stabilization
- Breathing
- Circulation
- Disability (neurological examination)
- Exposure

Any immediate threats to life detected during the initial assessment (primary) should be corrected when found. Following this, you should proceed to the detailed assessment (secondary), unless the child's condition requires immediate transport. Particular emphasis in the detailed assessment (secondary) should be on detection of the injuries, described in the following discussion.

## **Kinematics of Pediatric Trauma**

The size of a child produces a smaller target to which linear forces from fenders, bumpers, and falls are applied. Due to decreased fat, increased elasticity of connective tissue and close proximity of multiple organs, these forces do not dissipate well as in the adult and disperse more energy to multiple organs. The skeleton of a child is incompletely calcified and contains multiple active growth centers, which make it more resilient. However, it is less able to absorb the kinetic forces applied during a traumatic event and may allow significant internal injury with little or no external injury.

## **Head, Face and Neck Injuries**

The majority of children who sustain multiple trauma will suffer an associated head injury. Head injuries are the most common cause of death in pediatric patients. Children

are particularly prone to head injuries because their heads are proportionally larger and heavier in comparison to the rest of their body. The mechanism of injury resulting in head trauma varies based upon the age of the child. Infants and small children usually sustain head injuries during a fall. School-age children tend to sustain head injuries from bicycle accidents, falls from trees, or auto-pedestrian accidents. Older children most commonly sustain head injuries in association with sporting events. Remember, child abuse is a frequent cause of head injury. Always be alert for the signs and symptoms of child abuse. Common head injuries seen in children include skin lacerations, skull fractures, contusions, concussions, and intracranial hemorrhage.

Children also frequently injure their faces. The most common facial injuries are lacerations, secondary to falls. Young children are very clumsy as they first start walking. A fall onto a sharp object, such as the corner of a coffee table, can result in a laceration. Older children sustain dental injuries in falls from bicycles, skateboard accidents, fights, and sports activities.

Spinal injuries in children are not as common as in adults. However, because of a child's proportionally larger and heavier head, the cervical spine is vulnerable to injury. Any time a child sustains a head injury, always assume that a neck injury may also be present.

### **Chest and Abdomen Injuries**

Chest injuries are the second most common cause of pediatric trauma deaths. Most thoracic injuries result from blunt trauma. Pneumothorax and hemothorax can occur in the pediatric patient, especially if the mechanism of injury was a motor vehicle accident. Tension pneumothorax can also occur in childhood. Pediatric tension pneumothorax results in diminished breath sounds over the affected lung, shift of the trachea to the opposite side, and a progressive decrease in ventilatory compliance. The ribs are soft and pliable, and do not provide protection, so internal organs are more prone to injury.

Significant blunt trauma to the abdomen can result in injury to the spleen or liver. In fact, the spleen is the most commonly injured organ in children. Signs and symptoms of a splenic injury include tenderness in the left upper quadrant of the abdomen, abrasions on the abdomen, and occasionally, ecchymosis over the affected area. The liver is also frequently injured in blunt abdominal trauma. Symptoms of liver injury include right upper quadrant abdominal pain and/or right lower chest pain. Both splenic and hepatic injuries can cause life-threatening internal hemorrhage.

Because of the high mortality associated with blunt trauma, children with significant blunt abdominal or chest trauma should be transported immediately to a pediatric trauma center with appropriate care provided en route. Treat for shock with positioning, fluids, and maintenance of body temperature.

## Extremity Injuries



Extremity injuries in children are typically limited to fractures and lacerations. Children rarely sustain amputations and other serious extremity injuries. An exception includes farm children who may become entangled in agricultural equipment thus causing severe injuries to the extremities.

The most common injuries are fractures, usually resulting from falls. Because children have more flexible bones than adults, they tend to have incomplete fractures such as **bend fractures**, **buckle fractures**, and **greenstick fractures**. In younger children, the bone growth plates have not yet closed. Some types of growth plate fractures can lead to permanent disability if not managed correctly.

- **bend fractures** - fractures seen in children characterized by angulation and deformity in the bone without obvious break.
- **buckle fractures** - fractures seen in children characterized by a raised or bulging projection at the fracture site.
- **greenstick fractures** - fractures seen in children characterized by an incomplete break in the bone

## Burns

Burns are the second leading cause of death in children. Scald burns are the most common type of burn injury encountered. Children can burn themselves by pulling hot liquids off tables or stoves. Immersion in hot water can also cause a significant scald injury. Chemical burns, flame burns, and electrical burns also occur in children. The common problem following burns in children is infection. Skin injured by burns cannot protect against infection as effectively as normal skin can.

Estimation of the burn surface area is slightly different for children, as a general guide, the area of the patient's palm is approximately one per cent (1%) of the patient's body surface area. This can be used as a tool to estimate the total area burned. The following (Lund and Bowder Chart) can also be used in estimation of burn size in children.

<b>Area</b>	<b>0 years</b>	<b>1 year</b>	<b>5 years</b>	<b>10 years</b>	<b>15 years</b>
* ½ of head	9.5%	8.5%	6.5%	5.5%	4.5%
* ½ of one thigh	2.75%	3.25%	4%	4.25%	4.5%
*½ of one leg	2.5%	2.5%	2.75%	3%	3.25%

- whereas ½ refers to anterior portion or posterior portion (i.e. front of head)

Body surface area distribution in a young child or infant differs considerably from the body surface area distribution for an adult. The infant or young child's head represents a larger portion of the surface area, and the lower extremities a lesser proportion, when compared to an adult. The percentage of total body surface of the infant's head is twice that of a normal adult.

### **Shock**

**Shock** is a condition that develops when the circulatory system is unable to deliver a sufficient amount of blood to the organs of the body. This results in organ failure and eventually cardiopulmonary arrest. In children, shock is rarely due to a primary cardiac event, such as a heart attack. Shock may be due to many things; the most common causes include the following:

- Traumatic injury with blood loss (especially abdominal)
- Dehydration from diarrhea and vomiting
- Severe infection
- Neurologic injury such as severe head trauma
- A severe allergic reaction to an insect bite or allergy (anaphylaxis)
- Diseases of the heart
- A collapsed lung (pneumothorax)
- Blood or fluid around the heart (cardiac tamponade or pericarditis)

Infants and children have less blood circulating in their bodies than adults do, so the loss of even a small volume of fluid or blood may lead to shock. Pediatric patients also respond differently than adults to fluid loss. They may respond by increasing their heart rate so that it is 160 to 220 beats/min; they may also breathe quickly and/or appear pale or blue. You must be able to recognize the signs of shock in infants and children.

### **Assessments**

Begin by assessing the ABCD, intervening immediately as required; do not wait until you have completed a detailed assessment (secondary) to take action. Children in shock often have increased respirations but do not demonstrate a fall in blood pressure until shock is severe.

In assessing circulation, you should pay particular attention to the following:

**Pulse:** Assess both the rate and the quality of the pulse. A weak, “thready” pulse is a sign that there is a problem. The appropriate rate depends on age; anything over 160 beats/min suggests shock

**Skin signs:** Assess the temperature and moisture on the hands and feet. How does this compare with the temperature of the skin on the trunk of the body? Is the skin dry and warm, or cold and clammy?

**Capillary refill:** Squeeze a finger or toe for several seconds until the skin blanches, then release it. The time it takes for the blood to return to the area is the capillary refill time. Does the fingertip return to its normal color within 2 seconds, or is it delayed?

**Color:** Assess the patient’s skin color. Is it pink, pale, ashen, or blue?

Changes in pulse rate, color, skin signs, and capillary refill are all important clues suggesting shock.

Blood pressure is the most difficult vital sign to take in pediatric patients. The cuff must be the proper size: two thirds the length of the upper arm. Cuffs that are too large will give pressures that are lower than actual; cuffs that are too small will give pressures that are higher than actual. The value for normal blood pressure is also age-specific. Remember that blood pressure may be normal; this is called *compensated* shock. If the blood pressure is low, this is a sign of *decompensated* shock, a serious condition that requires care an ALS team can provide.

Part of your assessment should also include talking with the caregivers to determine when the signs and symptoms first appeared and whether any of the following has occurred:

- Decrease in urine output (with infants, are there fewer than 6 to 10 wet diapers/day?)
- Absence of tears, even when the child is crying
- Changes in level of consciousness and behavior

## **Management**

Shock is a serious condition; therefore you should limit your care to the following interventions:

1. Immobilize the entire spine if you suspect trauma.
2. Position the patient with the head lower than the feet by elevating the feet with blankets.
3. Ensure that the airway is open, and give supplemental oxygen by mask or nasal cannula as tolerated/required
4. Be prepared to provide artificial ventilation if necessary.
5. Control bleeding if present.
6. Keep the patient warm with blankets and by raising the rescue vehicle temperature.
7. Provide immediate transport to the nearest appropriate facility.

8. Continue monitoring vital signs en route to the hospital.
9. Start an IV (if protocols allow)
10. Contact ALS backup if available.
11. Whenever possible, allow a caregiver to accompany the child.

Limit your management to these simple interventions. Time should not be wasted in field procedures. Immediate transport is of utmost importance.

## ***Child Abuse and Neglect***

Child abuse should always be suspected, especially if injuries are not consistent with the history. There are several characteristics common to abused children. Often, the child is seen as “special” and different from others. Premature infants or a twin stand a higher risk of abuse than other children. Many abused children are less than 5 years of age. Handicapped children, as well as those with special needs, are also at greater risk. So are uncommunicative (i.e. autistic) children. Boys are more often abused than girls. A child who is not what the parents wanted (e.g. the wrong sex) is at increased risk for abuse too.

### **The Child Abuser**

The child abuser can come from any geographic, religious, ethnic, occupational, educational, or socio-economic group. However, people who abuse children tend to share certain characteristics. The abuser is usually a parent or someone in the role of a parent. When the mother spends most time with the child, she is the parent most frequently identified as the abuser. Most child abusers were abused themselves as children. Three conditions can alert you to the potential for abuse. They include:

- A parent or adult capable of abuse
- A child in one of the high-risk categories
- The presence of a crisis

Common crises that may precipitate abuse include financial stress, marital or relationship stress, and physical illness in a parent or child.

There are four major types of abuse found in children. They include physical abuse, sexual abuse, emotional / psychological abuse, and neglect.

### **Sexual Abuse**

Sexual abuse can occur at any age. The sexual abuser is almost always someone in the family, someone known to the family, or someone the child trust. Stepchildren or adopted children face a greater risk for sexual abuse by a parent than biological children. If you suspect the child has been sexually abused, examine the genitalia externally for serious injury. Avoid touching the child or disturbing the clothing. Police may need to

examine the child and the clothes for evidence. Your best approach to sexually abused children is one of caring support. If your region has a sexual assault team or program ensure that they are contacted.

### **Assessment of the Potentially Abused Child**

Signs of child abuse can be startling. As a guide, the following findings should trigger a high index of suspicion.

- Any obvious or suspected fractures in a child under 2 years of age.
- Injuries in various stages of healing, especially burns and bruises.
- More injuries than usually seen in children of the same age.
- Injuries scattered on many areas of the body.
- Bruises or burns in patterns that suggest intentional infliction (ex. cigarette burns, hand marks, bruises found on the buttocks, genitals, thighs, ears and face)
- Increased intracranial pressure in infants.
- Suspected intra-abdominal trauma in a young child.
- Any injury that does not fit with the description of the cause given.

Information in the medical history may also raise the index of suspicion. Examples include:

- A child who does not turn to the parent for comfort.
- A history that does not match the nature or severity of the injury.
- Vague parental accounts or accounts that change during the interview.
- Accusations that the child injured himself or herself intentionally.
- Delay in seeking help.
- Child dressed inappropriately for the situation.
- A child who seems apathetic and does not cry despite his/her injuries.

Suspect child neglect if you spot any of the following conditions.

- Extreme malnutrition
- Multiple insect bites
- Longstanding skin infections
- Extreme lack of cleanliness

### **Management of the Potentially Abused Child**

In cases of child abuse or neglect, the goals of management include: appropriate treatment of injuries, protection of the child from further abuse, and notification of proper authorities. You should obtain as much information as possible, in a non-judgmental manner. Document all findings or statements in the patient care report. Don't "cross-

examine” the parents; this job belongs to the police. Try to be supportive and non-judgmental toward the parents. However, you should make sure the child is transported to the hospital by the ambulance.

Upon arrival at the emergency department, report your suspicions to the emergency department personnel and the proper authorities. Complete the patient care report and all available documentation at this time, since delay may inhibit the accurate recall of data. Child abuse and neglect are particularly stressful aspects of emergency medical services. You must recognize and deal with your feelings, perhaps taking them up at a Critical Incident Stress Debriefing.

## ***Pediatric Medical Emergencies***

### **Infections (ear, nose, or throat, and skin rashes etc.)**

Most childhood medical emergencies involve the respiratory system. However, any body system can be involved. Infections are common during this period in life. Infectious diseases are those illnesses caused by the infection or infestation of the body by an infectious agent such as a virus, bacteria, fungus or parasite. Childhood is a time of frequent infectious illness due to the relative immaturity of the immune system. Most children will have 5-6 upper respiratory infections per year. Most infections are minor and self-limited. Children with infection may have a variety of signs and symptoms, depending on the source and extent of infection and the length of time since the patient was exposed. The following is a list of the possible signs and symptoms of infection in pediatric patients:

- Fever
- Hypothermia (neonates)
- Chills
- Tachycardia
- Cough
- Sore throat
- Nasal congestion
- Malaise
- Tachypnea
- Cool or clammy skin
- Respiratory distress
- Poor feeding
- Vomiting or diarrhea (or both)
- Dehydration
- Hypoperfusion
- Seizure
- Severe headache
- Irritability
- Lethargy
- Stiff neck

- Bulging fontanelle (infants)

Often the parent or caregiver provides a history of recent illness (e.g., fever, upper respiratory tract infection, skin rash, ear, nose or throat infections, pain, or drainage).

Most children with infection need only supportive care while being transported for evaluation by a physician. There are, however, several infections that can be life-threatening. These include meningitis, pneumonia, and bacterial septicemia.

In severe cases the patient may require airway, ventilatory, and circulatory support. If signs of decompensated shock are present, IV therapy may be warranted (per medical direction/access to protocol). Active seizure activity may require the administration of anticonvulsant agents (again if certified in protocol). When possible, children in stable condition should be transported in their position of comfort in the company of the parent or caregiver.

### **Neurological Emergencies**

Neurological emergencies in childhood are fairly uncommon. These include seizure, febrile seizures, Reye's syndrome, and meningitis, among others. Children can have intracranial bleeding significant enough to cause shock. Children suffer increased risk of apneic periods with head injuries.

### **Seizures**

Seizures can and do occur in children and are also a frequent reason for summoning EMS. Several factors have been identified as causing seizures. These include:

- Fever
- Hypoxia
- Infections (such as meningitis)
- Idiopathic epilepsy
- Electrolyte disturbances
- Head trauma
- Hypoglycemia (and other metabolic disorders)
- Toxic ingestions or exposure
- Tumor
- CNS malformations

Often, however, the etiology is not known. Status epilepticus can also occur in children. *Status epilepticus* is a prolonged seizure or multiple seizures with no regaining of consciousness between them. This is a serious medical emergency. Most pediatric seizures that involve EMS personnel are febrile seizures.

*Febrile seizures* are seizures that occur as a result of a sudden increase in body temperature. They occur most commonly between the ages of 6 months and 6 years. Febrile seizures seem related to the rate at which the body temperature increases, not to the degree of fever. Febrile seizures are difficult to diagnose in the field. Often, the parents will report the recent onset of fever or cold symptoms. All pediatric patients suffering a seizure must be transported to the hospital so that all etiologies can be excluded.

## **Assessment**

The history is a major factor in determining seizure type. Febrile seizure should be suspected if the temperature is above 103<sup>0</sup>F (39.2<sup>0</sup>C) and you are advised of a rapid onset. The history of a previous seizure may suggest idiopathic epilepsy or other CNS problem. However, there is a tendency for recurrence of febrile seizures in children who are predisposed.

When confronted with a seizing child, determine whether there is a history of seizures or seizures with fever. Has the child had a recent illness? Also, determine how many seizures occurred during the incident. If the child is not seizing upon arrival, elicit a description of seizure activity. Note the condition and position of the child when found. Question parents or bystanders about the possibility of a head injury. A history of irritability or lethargy prior to the seizure may indicate CNS infection. If possible, find out whether the child suffers from diabetes or has recently complained of a headache or a stiff neck. Note any current medications, as well as possible ingestions.

The physical examination should be systematic. Pay particular attention to the adequacy of respirations, the level of consciousness, neurological evaluation, and signs of injury. Also inspect the child for signs of dehydration. Dehydration may be evidenced by the absence of tears or, in an infant by the presence of a sunken fontanelle.

## **Management**

Management of the pediatric seizure is essentially the same as for the seizing adult. Place the patient on the floor or on the bed. Be sure to lay the child on his or her side, away from the furniture. Do not restrain the child, but take steps to protect him or her from injury. Maintain the airway, but do not force anything, such as a bite stick, between the teeth. Consider the use of an NPA to maintain the airway. Administer supplemental oxygen. Then take and record all vital signs. If the child is febrile, remove excess layers of clothing. If status epilepticus is present, transport without delay. Management of these emergencies may also include (where service protocols permit) starting an IV and administering diazepam for controlling seizures and acetaminophen to lower fever if child is febrile. Reassure and support parents; this is a very stressful and frightening situation for them.

## **Meningitis**

Meningitis is an infection of the meninges, the lining of the brain and spinal cord. Meningitis can result from both bacteria and viruses. Viral meningitis is frequently called *aseptic meningitis*, since an organism can not be routinely cultured from CSF fluid. Aseptic meningitis is generally less severe than bacterial meningitis and self-limited. Bacterial meningitis most commonly results from *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Neisseria meningitidis*. These infections can be rapidly fatal if not promptly recognized and treated appropriately. Meningitis can cause permanent damage to the brain and nervous system, and is sometimes the cause of deafness.

## **Assessment**

Meningitis is more common in children than in adults. Findings in the history that may suggest meningitis include: a child who has been ill for one day to several days, recent ear or respiratory tract infection, high fever, lethargy or irritability, a severe headache, or a stiff neck, may complain of sensitivity to light and in bacterial meningitis the child may also have a rash. The child with meningitis may present in various ways. Infants generally do not develop a stiff neck. They will generally become lethargic and will not feed well. Some babies may simply develop a fever. Documented fever in a child less than 3 months of age is considered meningitis until proven otherwise.

On physical examination, the child with meningitis will appear very ill. With an infant, the fontanelle may be bulging or full unless accompanied by dehydration. Extreme discomfort with movement, due to irritability of the meninges, may be present.

## **Management**

Recommended precautions for EMS personnel include wearing gloves, safety glasses and a mask. Pre-hospital care of the infant or child with meningitis is supportive. Rapidly complete the primary survey and detailed assessment (secondary). Then transport the infant to the emergency department. If shock is present treat the child with oxygen and intravenous fluids if local protocol permits.

## **Reye's Syndrome**

Reye's syndrome is an acute, potentially fatal disease of childhood, characterized by severe edema of the brain and increased intracranial pressure, hypoglycemia, and fatty infiltration and dysfunction of the liver.

Reye's syndrome is a disease that was undescribed until 1963. The etiology of Reye's syndrome has not been clearly established. Reye's syndrome affects all ages, with peak incidence between ages 5-15 years. It tends to occur more frequently in younger children. The frequency is higher in fall and winter. After 1 year of age, there is a higher incidence in the suburban and rural populations.

Although no single etiological factor has been identified, several possible toxic and metabolic causes have been postulated. Outbreaks tend to cluster during epidemics of Influenza B. Occasionally, it has been associated with the chicken pox (varicella) virus. Infants often will have a recent history of gastroenteritis. There has also been a correlation between the use of aspirin and the disease, particularly after the flu.

Reye's syndrome typically presents itself in a healthy child who develops severe nausea and vomiting during an unremarkable viral illness. Within hours, the patient may begin to display hyperactive or combative behavior. In addition, there may be personality change, irrational behavior, progressive stupor, restlessness, convulsions, and coma. The sudden onset of vomiting often marks the early stages of the disease. In approximately 10-20 percent of cases, there is a recent history of chicken pox. Other children may have had a recent upper-respiratory infection. Infants may have recently had gastroenteritis.

### **Assessment**

On physical examination, there may be rapid, deep respirations, which may be irregular. The pupils can be dilated and react sluggishly. There also may be signs of increased intracranial pressure, such as deviations in gaze. Unfortunately, Reye's syndrome cannot be diagnosed in the field. The diagnosis is difficult enough to make in the hospital.

Complications that can occur with Reye's syndrome include respiratory failure, cardiac arrhythmias, and acute pancreatitis. Death usually results from CNS complications such as herniation of the brainstem.

### **Management**

Management is general and supportive. Complete the initial assessment (primary survey) with particular attention on the respiratory status. Support ventilations, if necessary, and administer supplemental oxygen. Transport should be rapid. The prognosis depends on early diagnosis and control of the increased intracranial pressure.

## ***Respiratory Emergencies***

Respiratory problems are common in childhood. Children are susceptible to many of the respiratory problems that occur in adults. In addition, there are several problems that are unique to children. Respiratory problems should be identified in the initial assessment (primary) and treated appropriately. First, assess the airway. If it is obstructed, clear the airway using BLS techniques, if possible. Second, assess breathing. If the child is not breathing, you should initiate artificial ventilations.

Pediatric respiratory emergencies that deserve special attention include bronchiolitis, croup, epiglottitis, asthma, and aspiration of foreign bodies. Children with

any of these disorders can suffer respiratory arrest. This is most often due to airway obstruction or exhaustion.

### **Aspirated Foreign Body**

Children especially 1 to 3 year olds, are always putting objects into their mouths. These children are at increased risk of aspirating the object, especially when they are running or falling. In addition, many children choke on, or aspirate, food given to them by their parents or other well-meaning adults. Young children have not yet developed coordinated chewing motions in the mouth and pharynx and cannot adequately chew food. Common foods associated with aspiration and airway obstruction in children include chewing gum, hot dogs, grapes, peanuts, and sausages.

### **Assessment**

The children with a suspected aspirated foreign body may present in one of two ways. If the obstruction is complete, the child will not be breathing. If it is partial, the child may exhibit labored breathing, retractions, chest expansion, and cyanosis. A foreign body aspirated into the respiratory tree will often drop until it lodges. Large objects will lodge in the trachea or the mainstem bronchi. Smaller objects may drop to the bronchioles. Often, the food particle will act as a one-way valve, allowing the entry of air, while restricting its exit. This results in hyperexpansion of the affected lung. If severe, tracheal deviation, away from the involved lung, may be noted.



### **Management**

When confronted with a child suspected of aspirating a foreign body, immediately complete the primary survey. If complete obstruction is noted, clear the airway with accepted basic life support techniques.

If unsuccessful visualize the airway with a laryngoscope, (if trained to do so). If the foreign body is seen, and readily accessible, try to remove it with Magill forceps.

If the obstruction is partial, make the child comfortable and administer humidified oxygen. Be prepared to initiate BLS procedures as complete airway obstruction can

occur. The child should be transported to a hospital, where the foreign body can be removed by fiberoptic bronchoscopy.

## **Croup**

Croup, medically referred to as *laryngotracheobronchitis*, is a viral infection of the upper airway. It most often occurs in children 3 months to 3 years of age and is most prevalent in the fall and winter. The infection causes edema to develop beneath the larynx and glottis, narrowing the lumen of the airway. Severe cases of croup may result in incomplete airway obstruction.

## **Assessment**

The history for croup is fairly classic. Often, the child will have a mild cold or other infection and be doing fairly well until dark. After dark, however, a harsh, barking cough develops. The attack may subside in a few hours, but can persist for several nights.

The physical exam will often reveal inspiratory stridor. There may be associated nasal flaring, tracheal tugging, or retraction. You SHOULD NEVER examine the oropharynx. Often, in the pre-hospital setting, it is difficult to distinguish croup from epiglottitis. (See table below.) If epiglottitis is present, examination of the oropharynx may result in laryngospasm and complete airway obstruction. If the attack of croup is severe and progressive the child may develop restlessness, tachycardia, and cyanosis. Croup can result in complete airway obstruction and respiratory arrest.

When responding to possible croup or epiglottitis patients, the recommended precautions for EMS personnel include wearing gloves, safety glasses and a mask or face shield. An oxygen mask may be placed on the child if tolerated when epiglottitis is suspected.

## **Management**

Management of croup should consist of appropriate airway maintenance. Place the child in a position of comfort and administer humidified oxygen by face mask. Then prepare the child for transport to the hospital. The process of transporting the child from the house to the ambulance will often allow him or her to breathe the cool air. Because this cool air causes a decrease in subglottic edema, the child may be clinically improved by the time he or she reaches the ambulance. If the attack of croup is severe, Salbutamol via nebulizer may be considered. Some physicians advocate the use of steroids in croup, because they feel these drugs shorten the course of the illness.

## **Epiglottitis**

Epiglottitis is an acute infection and inflammation of the epiglottis and is potentially life-threatening. The epiglottis is a flap of cartilage that protects the airway during swallowing. Epiglottitis, unlike croup, is caused by a bacterial infection, usually

*Haemophilus influenzae*. Most commonly seen in children from the ages of 2 and 7, but may occur at any age. It is characterized by a swollen, cherry red epiglottis.

### Assessment

The child with epiglottitis is acutely ill. The presentation is similar to croup. Often, the child will go to bed feeling relatively well, usually with what the parents consider to be a mild infection of upper respiratory tract. Later, the child awakens with a high fever and a brassy cough. The progression of symptoms can be dramatic. There is often pain upon swallowing, sore throat, high fever, shallow breathing, dyspnea, inspiratory stridor, and drooling. Remember that most often it is a sudden onset, and rapid progression!

On physical examination, the child appears toxic. Most often, the child will be sitting with head forward, neck extended and mouth open, reluctant to speak. YOU SHOULD NEVER attempt to visualize the airway. Often, however when the child is crying, the tip of the epiglottis can be seen posterior to the base of the tongue. In epiglottitis, it is red and swollen. As airway obstruction develops, the child will exhibit retractions, nasal flaring, and pulmonary hyperexpansion.

### Management

Management of epiglottitis should consist of appropriate airway maintenance. Place the child in a position of comfort and administer humidified oxygen by face mask. Be prepared to intervene should complete airway obstruction occur. In cases of epiglottitis, transport the child to the hospital as quickly as possible. If total obstruction develops, attempts should be made to ventilate the patient with a BVM attached to supplemental oxygen.

### Symptoms of Croup and Epiglottitis

Croup	Epiglottitis
Slow onset	Sudden onset, rapid progression
Generally wants to sit up	Prefers to sit up
Barking cough	No barking cough
No drooling	Drooling; painful to swallow
Fever approx. 100-101 <sup>0</sup> F	Fever approx. 102-104 <sup>0</sup> F
	Occasional stridor

### Bronchiolitis

Wheezing in a child less than one year of age is frequently due to bronchiolitis. Bronchiolitis is a respiratory infection of the medium sized airways-the bronchioles-that occurs in early childhood, most commonly between the ages of 6 and 18 months. It should not be confused with bronchitis, which is an infection of the larger bronchi. Bronchiolitis is caused by a viral infection, most commonly *respiratory syncytial virus (RSV)*, which affects the lining of the bronchioles. Characterized by prominent expiratory wheezing, it clinically resembles asthma.

## **Assessment**

A history is necessary to distinguish bronchiolitis from asthma. Often, with bronchiolitis, there is a family history of asthma or allergies, although neither is yet present in the child. In addition, there often is a low-grade fever. A major distinguishing factor is age. Asthma rarely occurs before the age of one year, whereas bronchiolitis is more frequent in this age group. There is often a history of a cold; often the child has a runny nose.

The physical examination should be systematic. Pay particular attention to the presence of rales or wheezes. Also, note any evidence of infection or respiratory distress, including tachypnea and hypoxia.

## **Management**

Pre-hospital management of suspected bronchiolitis is much the same as with asthma. Place the child in a semi-sitting position, if old enough, and administer humidified oxygen by mask. Ventilations should be supported as necessary. If wheezing is present, and local protocols permit; administer Salbutamol via small volume nebulizer. The cardiac rhythm should be constantly monitored. Pulse oximetry, if available, should be used continuously.

## **Asthma**

Asthma is a common respiratory disease. It is the most common chronic illness in children. It occurs usually before the age 10 in approximately 50 percent of the cases, and before age 30 in an additional 33 percent of cases. The disease tends to run in families. It is also commonly associated with atopic conditions, such as eczema and allergies. Although deaths from other respiratory conditions have been steadily declining, asthmatic deaths have increased significantly in the last decade. Hospitalization of children for treatment of asthma has increased by 200 percent or more during the same interval. Because children can die from asthma, prompt pre-hospital recognition and treatment are essential.

## **Pathophysiology**

Asthma is a chronic inflammatory disorder of the airways. In susceptible children, this inflammation causes widespread, but variable, airflow obstruction. In addition to airflow obstruction, the airways become hyperresponsive.

Asthma may be induced by one of many different factors, commonly called “triggers”. The triggers vary from one child to the next. Common triggers include environmental allergens, cold air, exercise, foods, irritants, and certain medications.

Within minutes of exposure to the trigger, a two-phase reaction occurs. The first phase of the reaction is characterized by the release of chemical mediators such as histamine. These cause bronchoconstriction and bronchial edema that effectively decrease expiratory airflow, causing the classic “asthma attack”. If treated early, asthma may respond to inhaled bronchodilators. If the attack is not aborted, or does not resolve spontaneously, a second phase may occur. The second phase is characterized by inflammation of the bronchioles as cells of the immune system invade the respiratory tract. This causes additional edema and further decreases expiratory airflow. The second phase will typically not respond to inhaled bronchodilators. Instead, anti-inflammatory agents, such as corticosteroids are often required.

As the attack continues, and swelling of the mucous membranes lining the bronchioles worsens, there may be plugging of the bronchi by thick mucus. This further obstructs airflow. As a result, there is an increase in sputum production. In addition, the lungs become progressively hyperinflated since airflow is more restricted on exhalation. This effectively reduces vital capacity and results in decreased gas exchange at the alveoli, resulting in hypoxemia. If allowed to progress untreated, hypoxemia will worsen, and unconsciousness and death may ensue.

### **Assessment**

Asthma can often be differentiated from other pediatric respiratory illnesses by the history. In many cases, there is a prior history of asthma or reactive airway disease. The child’s medications may also be an indicator. Children with asthma often have an inhaler or take a theophylline or oral beta agonist preparation.

On physical examination, the child is usually sitting up, leaning forward, and tachypneic. Often, there is an associated unproductive cough. Accessory respiratory muscle usage is usually evident. Wheezing may be heard. However, in a severe attack, the patient may not wheeze at all-this is an ominous finding. Generally, there is an associated tachycardia, and this should be monitored, since virtually all medications used to treat asthma increase the heart rate.

### **Management**

The primary therapeutic goal in the asthmatic is to correct hypoxia, reverse bronchospasm, and decrease inflammation. First, it is imperative that you establish an airway. Next, administer supplemental, humidified oxygen as necessary. As local protocols allow, also administer a nebulized bronchodilator medications (Salbutamol).

### **Status Asthmaticus**

Status asthmaticus is defined as a severe, prolonged asthma attack that cannot be broken by repeated doses of epinephrine. This is a serious medical emergency and prompt recognition, treatment, and transport are required. Often, the child suffering status asthmaticus will have a greatly distended chest from continued air trapping. Breath sounds, and often wheezing, may be absent. The patient is usually exhausted, severely acidotic, and often dehydrated. The management of status asthmaticus is basically the

same as asthma. However, you should recognize that respiratory arrest is imminent and remain prepared for advanced airway management. Transport should be immediate, with aggressive treatment continued en route.

## ***Gastrointestinal Emergencies***

Childhood gastrointestinal problems almost always present with nausea and vomiting as a chief complaint. As a child gets older, gastrointestinal system emergencies, such as appendicitis, become more common.

### **Nausea and Vomiting**

Nausea and vomiting are symptoms of other disease processes. Virtually any medical problem can cause nausea and vomiting in a child. Fever, ear infections, and respiratory infections are common causes of nausea and vomiting. In addition, many viruses, and certain bacteria, can infect the gastrointestinal system. These infections, collectively called *gastroenteritis*, readily cause vomiting, diarrhea, or both.

The biggest risks associated with nausea and vomiting in children are dehydration and electrolyte abnormalities. Infants and toddlers can quickly become dehydrated from bouts of vomiting. If diarrhea or fever is also present, fluid loss is further accelerated, worsening the situation. Dehydration in infants and toddlers is more difficult to detect compared to older children.

Treatment of pediatric nausea and vomiting is primarily supportive. If the child is dehydrated, and unable to keep oral fluids down, intravenous fluid therapy (where protocols allow) may be indicated. Severe dehydration, is evidenced by prolonged capillary refill time of more than 2 seconds.

### **Diarrhea**

Diarrhea is a common occurrence in childhood. Often, what parents call diarrhea is actually loose bowel movements. Generally, 10 or more loose stools per day is considered diarrhea. As with nausea and vomiting, the main concern associated with diarrhea is dehydration. Most diarrhea is due to viral infections of the gastrointestinal system or secondary to infections elsewhere in the body. However, certain bacterial infections can cause significant, even life-threatening, diarrhea.

Treatment of the child suffering diarrhea is primarily supportive as mentioned above for nausea and vomiting.

### ***Signs and Symptoms of Dehydration***

<b>Signs/Symptoms</b>	<b>Mild</b>	<b>Moderate</b>	<b>Severe</b>
<i>Vital Signs</i>			
Pulse	normal	increased	markedly increased
Respirations	normal	increased	tachypneic
Blood Pressure	normal	normal	hypotensive

Capillary Refill	normal	2-3 seconds	>2 seconds
<i>Mental Status</i>	alert	irritable	lethargic
<i>Skin</i>	normal	dry and ashen	dry, cool, mottled
<i>Mucous Membranes</i>	dry	very dry	very dry/no tears

## ***Cardiovascular Emergencies***

Cardiovascular emergencies in children most commonly result from volume depletion due to severe dehydration, hemorrhage, or severe infection. With the exception of congenital heart disease, cardiac emergencies in children are extremely rare. Cardiac arrest in children usually follows respiratory arrest. The criteria for using an AED on a child is a minimum age of 1 year old. Pediatric pads are preferred for children 1 to 8 years of age but are not essential. Management for children in cardiac arrest consists of performing BLS procedures as outlined by the Heart and Stroke Foundation and use of an AED if the rhythm is ventricular fibrillation or pulseless ventricular tachycardia. Lethal dysrhythmias, such as ventricular fibrillation, ventricular tachycardia, or high-grade heart blocks rarely occur in children.

## **Dehydration**

Dehydration is defined as the lack of adequate body fluids for the body to carry on normal functions at an optimal level; by loss, inadequate intake, or both. The child is very vulnerable to dehydration. Among the causes are diarrhea, vomiting, poor fluid intake, fever, and burns. Children have a high body-surface-area-to-weight ratio. Therefore, they are very vulnerable to heat loss, and along with it, dehydration. They also have a higher percentage of water to body tissues than adults. Fluid losses up to 5% are considered mild; up to 10% are considered moderate; and up to 15% are considered severe.

## **Assessment**

When confronted with a dehydrated child, question the parents about recent infection, diarrhea, vomiting and fever. Also, ask them about decreased urination. Many parents will notice that their children are wetting fewer diapers than usual.

Physical examination may show decreased skin turgor, weight loss, and absent tears. Urine may be quite concentrated. The eyes may be dull and sunken-looking. Infants may exhibit a depressed anterior fontanelle. The child may have altered mental status or poor pain response. The table on the previous page will help you determine the severity of dehydration.

## Management

The management of dehydration should first include the initial assessment (primary): airway, breathing, and circulation. The vital signs should be determined and monitored. If the child is in shock, and age/protocol permits; start an IV of normal saline. Do not delay transport however if there is difficulty in starting an IV. Severe dehydration can result in cardiovascular collapse and death if not treated quickly.

## Sepsis

Sepsis is a bacterial infection of the bloodstream. It usually occurs as a complication of an infection at another site such as pneumonia, an ear infection, or a urinary tract infection. Meningitis is frequently associated with sepsis. The etiology can be varied, as can the presenting signs and symptoms. Occasionally, the focus of infection cannot be initially determined. Newborns and small infants are at increased risk of developing sepsis as their immune systems are still relatively immature.

The septic child is critically ill. **Septic shock** may develop due to the release of deadly toxins by the bacteria causing the infection. These toxins cause peripheral vasodilation, leading to drop in blood pressure and decreased tissue perfusion. Sepsis can be rapidly fatal if not promptly identified and treated.

## Assessment

Suspect sepsis in any child who becomes ill or who has been ill for several days, especially if accompanied by fever, lethargy, irritability, or shock. Initial management of the septic child includes the initial assessment (primary) and detailed assessment (secondary). Signs and symptoms of sepsis include:

- Ill appearance
- Irritability or altered mental status
- Fever
- Vomiting and diarrhea
- Cyanosis, pallor, or mottled skin
- Nonspecific respiratory distress
- Poor feeding

Signs and symptoms of septic shock include:

- Very ill appearance
- Altered mental status
- Tachycardia
- Capillary refill time greater than 2 seconds
- Hyperventilation, leading to respiratory failure
- Cool and clammy skin

- Inability of child to recognize parents

## **Management**

The initial assessment (primary) should be completed. Secure and maintain the airway and assist ventilation as required. Administer supplemental oxygen at a high concentration. If protocol allows, establish IV access and begin infusion of normal saline. Shock can develop and should be anticipated and treated appropriately. Sepsis is a very serious condition that can deteriorate quickly. It must be promptly recognized and treated appropriately. The goal is to prevent the development of septic shock.

## **Dysrhythmias**

Dysrhythmias in children are uncommon and usually due to non-cardiac problems. The most common pediatric dysrhythmia is bradycardia. It usually results from hypoxia, hypotension, or acidosis. Supraventricular tachycardia can also occur in children. Although a rare disorder, supraventricular tachycardia can cause sustained heart rates of 200 beats per minute or greater. Heart rates in excess of 200 beats per minute do not allow for adequate ventricular filling. Because of this, cardiac output may fall, resulting in decreased tissue perfusion. Asystole is usually a terminal event, following prolonged, untreated bradycardia. Ventricular fibrillation in children is rare and usually results from serious electrolyte imbalances.

Treatment of pediatric dysrhythmias is much the same as for adults. However, algorithms have been developed for the treatment of pediatric bradycardia and pediatric asystole.

## **Congenital Heart Disease**

Congenital heart disease is an abnormality or defect in the heart present at birth. It is the primary cause of heart disease in children. Most congenital heart problems are detected at birth. Some, however, are not discovered until later in childhood. The most common emergency due to congenital heart disease is cyanosis. This occurs when blood going to the lungs for oxygenation mixes with blood bound for other parts of the body. This may result from holes in the internal walls of the heart or abnormalities of the great vessels.

The child with congenital heart disease may develop respiratory distress, congestive heart failure, or a “cyanotic spell”. *Cyanotic spells* occur when oxygen demand exceeds that provided by the blood. It begins as irritability, inconsolable crying, or altered mental status. Severe dyspnea may develop, including progressive cyanosis. In severe and prolonged cases, seizures, coma, or cardiac arrest may result. Non-cyanotic problems associated with congenital heart disease include respiratory distress, tachycardia, decreased end-organ perfusion, drowsiness, fatigue, and pallor.

Treatment includes the standard initial assessment (primary). Administer oxygen at a high concentration. If necessary, provide ventilatory support. If the child is having a

cyanotic spell, place him or her in the knee-chest position facing downward. This will help decrease the cardiac workload. Apply the ECG monitor, and start an intravenous line at a TKO rate (if local protocol allows). Transport immediately.

## ***Other Pediatric Emergencies***

### **Anaphylaxis**

Anaphylaxis is an allergic reaction in the most severe form. It is an acute, generalized reaction that may be rapidly fatal even with prompt and appropriate medical care. An antigen is a foreign substance to which the body mounts an immune response. Examples of potent antigens include antibiotics (penicillins, sulfas), insect stings (bees, wasps), foods (peanuts, strawberries), or other substances (perfumes, cleaning agents). Antigens such as these are often referred to as “allergens” because of the allergic response produced.

Anaphylaxis may develop in seconds to minutes after the ingestion, injection, inhalation, or absorption of the antigenic substance. Anaphylaxis is an emergency that requires prompt recognition of the condition and appropriate treatment by EMS personnel. This initial treatment may be life saving.

### **General (Signs and Symptoms, Assessment and Management)**

- Personal protective equipment should be utilized and safety precautions in place (swarms of bees/wasps)
- Routine Practices (BSI) techniques and equipment should be utilized as appropriate
- Initial assessment (primary))
- Administer high concentration oxygen
- Assess the patient for symptoms or signs that may indicate a moderate or severe anaphylactic reaction
  - abdominal cramps, nausea, vomiting
  - altered level of consciousness
  - vital signs
    - ⇒ tachycardia or bradycardia (late finding)
    - ⇒ tachypnea
    - ⇒ elevated blood pressure or decreased blood pressure (if reaction is severe)
  - respiratory system
    - ⇒ swelling of the face, mouth, throat
    - ⇒ wheezing, stridor, difficulty with secretions
    - ⇒ partial or complete airway obstruction
  - cardiovascular system
    - ⇒ chest tightening or pain
  - skin
    - ⇒ local warmth and swelling, urticaria (hives), rash

- ⇒ swelling of extremities
- Obtain a focused history
  - time of onset of symptoms
  - possible source of exposure to allergen(s)
  - known sensitivities and allergies
  - medical identification, such as Medic Alert bracelet, anklet or neck chain
  - medications the patient takes
    - ⇒ routinely to prevent reactions
    - ⇒ in emergency situations for anaphylaxis
  - whether patient has self-administered any emergency medications
    - ⇒ name of medication(s)
    - ⇒ dose of medication(s)
    - ⇒ time(s) of administration
    - ⇒ number of doses
    - ⇒ results of medication(s)

### **Administration of Epinephrine**

- EMS personnel trained and certified to treat anaphylaxis using epinephrine may do so as outlined in the Anaphylaxis Protocol
  - EMS personnel should administer epinephrine to the patient as early as possible
    - ⇒ refer to Anaphylaxis Treatment Protocols
- Initiate transport
  - on scene times should be kept to a minimum
  - treat other life-threatening conditions en route
- Transport the patient to the nearest appropriate health care facility
  - notify the receiving health care facility of the patient's status as soon as possible
  - monitor and treat the patient en route
  - high concentration of oxygen should be delivered to the patient
  - be prepared to support respiratory and circulatory functions
  - additional surveys and treatments should be conducted en route
- Report all findings to the receiving facility staff, and document on the patient care report

### **Special Consideration**

- Anaphylaxis is a true medical emergency-time to initial treatment and definite care are critical
  - rapid assessments, appropriate interventions, and early load and go can impact on the patient's outcome

- Respiratory compromise in the setting of anaphylaxis is an indication for immediate transport
- A “hoarse” voice in a patient having an allergic reaction is a danger signal of an impending airway obstruction
- If an insect stinger is imbedded in the skin, remove by scrapping with a fingernail or scissors
  - do not grasp the stinger to remove it
  - do not delay load and go to remove stinger
- If time permits, remove jewelry from the affected area
  - once the area is swollen, it may be difficult to remove and may cause distal neurovascular compromise
- If the anaphylactic reaction is possibly due to a substance injected into an extremity, refer to the injected Poison section of the Poisoning Treatment Guideline

### Note

- Patients typically have a past medical history of allergies or anaphylaxis due to specific known allergens
  - patients may have an anaphylactic reaction the first time they come into contact with a substance
- In many cases, the patient will have their own epinephrine and delivery device
  - while the patient may self-administer their own medication, EMS personnel should use the epinephrine and delivery device carried by EMS
    - ⇒ this ensures the epinephrine is not expired, is delivered with aseptic techniques, and negates the need for the patient to exert him/herself in the delivery process
    - ⇒ this also ensures consistency in drug delivery in all patients

### Altered Mental State

People who are aware of themselves and their surroundings are said to be *conscious*. Nonverbal infants may demonstrate consciousness by following a person’s face or an object (tracking) by babbling and cooing, or by crying. Infants and children may exhibit an **altered mental state** (also called altered level of consciousness) in many ways, including lack of response to vocal commands and pain, combative behavior, confusion, thrashing about, drifting into and out of an alert state, or a change in the pitch and nature of their cry. Be aware of the many terms that are used to describe an altered mental state, including coma, delirium, and stupor. However, you should avoid using all of these terms, as none are accurate.

Common causes of altered mental state or altered level of consciousness in a pediatric patient include the following:

- Head trauma

- Shock
- Meningitis
- Seizures
- Brain tumor
- Intracranial bleeding
- Metabolic disease such as diabetes
- Low blood glucose
- Severe dehydration
- Lack of oxygen to the brain
- Stroke

Your first step in caring for a patient with an altered level of consciousness is to assess ABCD and provide appropriate care as necessary. As you determine responsiveness, remember to use the AVPU scale. Then obtain a brief history from the patient's caregivers, focusing on the following points:

- Does the patient have any illnesses?
- Does the patient take any medications? When was the last dose?
- Did the patient ingest any substances (eg. poisons, drugs, or plant material)?
- Has the patient been ill?
- Has the patient had any behavior problems?

Next, observe the child's pupils: Are they dilated or pinpoint? Do they react to a light by constricting? Are the eyes turned to the right, left, up or down? Is the child staring without moving his/her eyes? Is the child posturing?

Once you have completed your initial assessment (primary), immediately secure the airway. If respirations are inadequate, provide assisted ventilation with a BVM device. If you suspect trauma, log roll the child onto a backboard, and apply a cervical collar. If a collar is not available, tape the child's head to the backboard with towel rolls on both sides of the neck to prevent movement. Give supplemental oxygen by mask or nasal cannula.

If the child is actively seizing, follow the care described in the Treatment Guidelines for Seizures. No matter what the cause, you should support for the patient's vital functions and provide prompt transport.

### **Sudden Infant Death Syndrome (SIDS)**

In addition to the pediatric emergencies previously discussed, you should be familiar with Sudden Infant Death Syndrome (SIDS). SIDS is a sad and difficult situation for both parents and pre-hospital personnel. An understanding of SIDS is essential in order to enable you to deal effectively with this heart-breaking emergency.

Sudden Infant Death Syndrome (SIDS) is defined as the sudden death of an infant during the first year of life from an illness of unknown etiology. The incidence of SIDS in Canada is approximately 1 death per 1,000 births. SIDS is the leading cause of death between 1 week and 1 year of age in Canada. It is responsible for a significant number of

deaths between 1 month and 6 months of age, with peak incidences occurring at 2-4 months.

Death usually occurs during sleep. The incidence seems to be greater during winter and is more common in males than in females. It is more prevalent in families with younger mothers and in those from low socioeconomic groups. A higher incidence is also reported in infants with low birth weight. Occasionally, a mild upper respiratory infection will be reported prior to the death. SIDS is not caused by external suffocation from blankets or pillows. Neither is it related to child abuse, regurgitation and aspiration of stomach contents, or allergies to cow's milk. It is not hereditary, but does tend to recur in families.

Current theories vary about the etiology. Some authorities feel it may result from an immature respiratory center in the brain that leads the child to simply stop breathing. Others feel there may be an airway obstruction in the posterior pharynx, as a result of pharyngeal relaxation during sleep, a hyper-mobile mandible, or an enlarged tongue. There are many other theories and investigation continues.

Other potential risk factors include:

- sleeping on the stomach
- tobacco use in the home
- adolescent mothers
- lack of prenatal care
- crowded living conditions
- drug use during pregnancy
- multiple births
- African American & Native American ethnicity

### **Assessment**

Infants suffering SIDS have similar physical findings. From an external standpoint, there is a normal state of nutrition and hydration. The skin may be mottled. There are often frothy, occasionally blood-tinged, fluids in and around the mouth and nostrils. Vomitus may be present. Occasionally, the infant may be in an unusual position, due to muscle spasm at the time of death. Common findings noted at autopsy include intrathoracic petechia (small hemorrhages) in 90 percent of cases. There is often associated pulmonary congestion and edema. Sometimes, stomach contents are found in the trachea. Microscopic examination of the trachea often reveals the presence of inflammatory changes.

### **Management**

The immediate needs of the family with a SIDS baby are many. Undertake active and aggressive care of the infant to assure the parents that everything possible is being done. If death of the baby is obvious, it may be important to the family that the child is Baptized immediately. Regardless of your religion, you may facilitate this wish if you feel comfortable. Otherwise you can make arrangements to call the family's minister or priest. To perform the baptism, sprinkle a few drops of water on the baby's head, and repeat the exact words, "*I baptize you in the name of the Father, and of the Son, and of the Holy Spirit*". One medic should be assigned to assist the parents and to explain the procedures. After arrival at the hospital, direct management and care for the parents,

since often nothing can be done for the child. If the infant is dead, allow the family to see the child. Expect a normal grief reaction from the parents. Initially, there may be shock, disbelief, and denial. Other times, the parents may express anger, rage, hostility, blame or guilt. Often, there is a feeling of inadequacy as a parent, as well as helplessness, confusion, and fear. The grief process may last as long as 1-2 years. SIDS has a major long-term effect on family relationships.

### ***Legal Responsibilities and Implications of Treating Pediatric Patients***

The following are excerpts from the Child Protection Act.

#### **PART III: CHILD PROTECTION**

##### **Child in Need of Protection**

- 17(1) For purposes of this Act, a child is in need of protection where the life, health or emotional well-being of the child is endangered by the act or omission of a person.

**S.M. 1986-87, s.8; SM. 1989-90, c. 3,s.3.**

##### **Illustrations of Child in Need**

- 17(2) Without restricting the generality of subsection (1), a child is in need of protection where the child:
- (a) is without adequate care, supervision or control;
  - (b) is in the care, custody, control or charge of a person
    - (i) who is unable or unwilling to provide adequate care, supervision or control of the child, or
    - (ii) whose conduct endangers or might endanger the life, health or emotional well-being of the child, or
    - (iii) who neglects or refuses to provide or obtain proper medical or other remedial care or treatment necessary for the health or well-being of the child or who refuses to permit such care or treatment to be provided to the child when the care or treatment is recommended by a duly qualified medical practitioner;
  - (c) is abused or is in danger of being abused
  - (d) is beyond the control of a person who has the care, custody, control or charge of the child;
  - (e) is likely to suffer harm or injury due to the behavior, condition, domestic environment or associations of the child or of a person having care, custody, control or charge of the child;
  - (f) is subjected to aggression or sexual harassment that endangers the life, health or emotional well-being of the child;
  - (g) being under the age of 12 years, is left unattended and without

reasonable provision being made for the supervision and safety of the child, or  
(h) is the subject, or is about to become the subject, of an unlawful adoption under section 63 or of an unlawful sale under section 84.

S.M. 1986-87, c. 19, ~.8; **S.M.** 1989-90, c. 3, ~.3.

## **Reporting a Child in Need of Protection**

- 18(1) Subject to subsection (1.1), where a person has information that leads the person reasonably to believe that a child is or might be in need of protection as provided in section 17, the person shall forthwith report the information to an agency or to a parent or guardian of the child.  
S.M. 1989-90, c. 3, s.4.

## **Reporting to Agency Only**

18(1.1) Where a person under subsection (1):

- (a) does not know the identity of the parent or guardian of the child;
- (b) has information that leads the person reasonably to believe that the parent or guardian
  - (i) is responsible for causing the child to be in need of protection, or
  - (ii) is unable or unwilling to provide adequate protection to the child in the circumstances; or
- (c) has information that leads the person reasonably to believe that the child is or might be suffering abuse; subsection (1) does not apply and the person shall forthwith report the information to an agency.

S.M. 1989-90, c. 3, s.4.

## **Duty to Report**

- 18(2) Notwithstanding the provisions of any other Act, subsection (1) applies even where the person has acquired the information through the discharge of professional duties or within a confidential relationship, but nothing in this subsection abrogates any privilege that may exist because of the relationship between a solicitor and the solicitor's client.

## **Protection of Informant**

- 18.1(1) No action lies against a person for providing information in good faith and in compliance with section 18.

S.M. 1989-90, c. 3, s. 5.

## **Identity of Informant**

- 18.1(2) No person shall, except as required in the course of a judicial proceeding, disclose to the family of a child reported in need of protection the identity of the informant under section 18 without the written consent of the informant.

**S.M. 1989-90, c. 3, s.5.**  
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### **No Interference or Harassment**

18.1(3) No person shall interfere with or harass an informant under section 18.

**S.M. 1989-90, c. 3, S. 5.**

### **Director Reports to Professional Organizations**

18.2(1) Where the director has reasonable grounds to believe that a person has caused a child to be in need of protection as provided in section 17 or has failed to report information in accordance with section 18, the director may report the person to the professional society or association or regulatory organization of which the person is a member or that governs the professional status of the person.

**S.M. 1898-90, C. 3, s.5.**

## Glossary of Terms

**anaphylaxis:** an acute, generalized, and violent antigen-antibody reaction that can be rapidly fatal.

**bend fracture:** fracture seen in children characterized by angulation and deformity in the bone without obvious break.

**bronchiolitis:** viral infection of the medium-sized airways, occurring most frequently during the first year of life.

**buckle fracture:** fracture seen in children characterized by a raised or bulging projection at the fracture site.

**child abuse:** any improper or excessive action that injures or otherwise harms a child or infant.

**congenital:** present at birth

**croup:** laryngotracheobronchitis, a common viral infection of young children, resulting in edema of the sub-glottic tissues. Characterized by barking cough and inspiratory stridor.

**dehydration:** an abnormal decrease in total body water.

**epiglottitis:** bacterial infection of the epiglottis, usually occurring in children older than age 4. A serious medical emergency.

**epinephrine:** major hormone secreted by the adrenal medulla in response to sympathetic stimulation; a major mediator of the sympathetic response.

**febrile:** denoting or relating to fever.

**fontanelles:** areas in the infant skull where bones have not yet fused. Posterior and anterior fontanelles are present at birth.

**glottis:** the slit-like opening between the vocal cords.

**greenstick fracture:** fracture seen in children characterized by an incomplete break in the bone.

**meningitis:** infection and inflammation of the meninges, the covering of the brain and spinal cord.

**neonate:** an infant from the time of birth to one month of age.

## ***Glossary of Terms***

**Reye's syndrome:** illness of uncertain etiology that results in alteration of mental function in children. Often associated with viral infections and the use of aspirin.

**sepsis:** the presence of an infectious agent, usually bacteria, in the blood stream.

**septic shock:** type of shock which accompanies a bacterial infection, often due to release of endotoxins by the bacteria.

**status epilepticus:** the term used to describe a continuous seizure or multiple seizures without return to consciousness for 30 minutes.

**stridor:** a high-pitched "crowing" sound, caused by restriction of the upper airway.

**sudden infant death syndrome (SIDS):** illness of unknown etiology that occurs during the first year of life.

**wheezing:** whistling type breath sound associated with narrowing or spasm of the smaller airways.

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