More than 20,000 pediatric deaths occur each year in the United States. This disturbing number validates how important it is that EMS providers are educated to effectively assess and manage the critical pediatric patient. Providing the best care possible can only be achieved by obtaining an appropriate history, coupled with an accurate physical exam. EMS providers must be capable of identifying any and all immediate or potential life threats in a child. Obtaining a reliable history and physical exam on a pediatric patient can be challenging at best, and communication tactics are certainly important to their success. Let’s address some simple, yet effective tactics for pediatric assessment, along with a few recommendations for success in procedural performance.

A General Approach to Pediatric Assessment

Approach to the pediatric patient varies with the patient’s age and the nature of illness or injury. It is critical that EMS providers be cognizant of the emotional and physiological needs of a child throughout the assessment. It is equally important to identify the needs of the child's family members. In this stressful environment, family members will be trying to find the cause of injury or illness in their child and may be unruly when the answers they seek are not available or are contrary to what is expected.

In many pediatric scenarios, EMS providers tend to rely on family members as their primary historians. However, as children become older, they may be as good as or better than their caregivers at providing an accurate medical history. Although you should attempt to collect the history from children who are four years of age or older, older children are typically better at localizing pain or explaining their symptoms.
The key to pediatric assessment in EMS is to identify and manage immediate life threats. It is often easy to determine whether a child is sick just by looking at him. Sick kids look sick. If a child is active, appropriate and alert, he is not sick. The opposite is true as well. If a child is inactive and non-interactive, assume he is sick until proven otherwise.

**Forming a General Impression**

The most widely accepted approach to forming a general impression in a child is using the Pediatric Assessment Triangle--an objective tool developed by the American Academy of Pediatrics that can be used to determine the severity of illness in a child. This tool is especially useful because the assessment criteria are determined during the general impression. This assessment can be performed from across the room, before contact with the patient is ever made. The triangle is composed of three sides: appearance, work of breathing and circulation.

- Appearance relates to the child's overall mental status, body position and muscle tone.
- Work of breathing relates to the visual effort or audible sounds associated with respiration.
- Circulation is assessed by determination of skin color.

**Initial Assessment**

Following implementation of the pediatric assessment triangle (PAT) to form a general impression, assess the child's level of consciousness, ABCs and vital signs.

It is important to realize that "normal vital signs" is a relative term. Children of various ages have different metabolic needs and therefore have different normal values. EMS providers should not rely on their memory to recognize normal versus abnormal vital signs. There are dozens of quick-reference charts or tools that can be used to aid in determining normal vital sign ranges. It is equally important to remember that there are few instances where a single
vital sign or set of vital signs has any clinical significance. Vital signs are most beneficial and clinically relevant when they are used for trending changes in the patient's status over time.

**EMS MNEMONIC FOR PEDIATRIC ASSESSMENT**

When you're conducting a primary and secondary assessment in a sick child, the following mnemonic provides a bit more detail than the traditional ABCs, highlights common pediatric-specific considerations and ensures steps are not missed in the examination:

**Airway**—Patency, positioning, breath sounds, obstruction

**Breathing**—Work of breathing, nasal flaring, grunting

**Circulation**—Heart rate, perfusion, pulses, skin temperature

**Disability**—Level of consciousness, response to environment

**Expose by removing all clothing and diapers**

**Fahrenheit**—Determine body temperatures (hot, normal, cold)

**Get**—Vitals: temperature, pulse, respiratory rate, weight, BP

**Head**—Head-to-toe exam and history

**Inspect**—Inspect for evidence of trauma or signs of illness.

**Disability**

The AVPU scale is a universally accepted method for determining the degree of mentation in both adults and children. An additional method of determining mentation in a noncommunicative child is the TICLS (pronounced tickles) scale.

When you make initial contact with a pediatric patient, think about the five elements of the TICLS mnemonic as part of your initial assessment. They will give you a solid starting point when developing an initial impression. Here they are:

**T is for Tone**

Is the child active or listless? Does the child physically engage with you or do they remain limp and allow you to move them like a puppet or a doll. When you place a finger or object in the child’s hand, do they attempt to grab it or do they allow it to lie in their open hand? Babies normally lose their head-lag by three months. Does the child support the weight of their own head when picked up or do they allow their head to fall back against a supporting object?
I is for Interactiveness

Does the child want to play and interact with you? Does the child primarily want their eyes open or closed? If they are frightened of you, do they attempt to actively avoid you? Can you gain the child’s interest and engage them in play or activity. Do they desire a toy or instrument when offered? How do they respond to unusual sounds in their environment? Will they turn to investigate and unknown sound or auditory stimuli?

C is for Consolability

Can the child be appropriately agitated and calmed by caregivers and clinicians? Are they behaving as we would predict to external stimuli? For instance, we would expect a child who is normally calm in a parents arms to be calm when properly consoled and comforted in the arms of a familiar caregiver. We would also expect that a child who normally exhibits stranger anxiety to become agitated when taken from familiar caregivers and removed from their presence. Is the child’s temperament consistent with what we might normally expect for their environment?

L is for Look (or Gaze)

Does the infant or child fix their gaze on your face or other appropriately interesting object or do they gaze off into space? Infants find their world fascinating and should actively look toward new and interesting stimuli. Look for signs of active looking and be concerned about the “lights-are-on-but-nobody’s-home” type gaze.

S is for Speech (or Cry)

When the infant or child uses their voice is it a strong expression, a weak cry or absent of sound? Is the child’s speech spontaneous and self-initiated or does the child only use their voice when prompted or stimulated? Is this the volume and tone that you would expect from a child or infant in this age range?

The TICLS mnemonic can help you decide in the first few minutes of evaluation if you need to move fast or if you have time to stay on scene and do a more in depth evaluation. Notice that none of the points of the “tickles” evaluation involve taking vital signs or even touching the child. Most of this exam can be completed while the child is in a caregivers arms.

You can check through your “tickles” mental checklist while you are still warming up your hands. Once you do start touching and feeling the patient, work of breathing and skin signs should be the next priorities in your physical evaluation.
Also keep in mind that all of the parameters of the “tickles’ assessment need to be compared with the infants baseline behavior and his or her environment. If the child has been awake all afternoon and is late for nap time, their interactiveness, look and tone may be naturally depressed. If the child hasn’t been fed, their consolability may be understandably abnormal.

Use the parents as a guide for what is baseline for a given child. Trust their input and trust your gut.

A final method used for determining mentation is the pediatric Glasgow Coma Score or PGCS It is important to note that the standard GCS model must be modified in the noncommunicative child.

<table>
<thead>
<tr>
<th>Eye Opening</th>
<th>Best Verbal Response Age older than 5 Yrs.</th>
<th>Best Verbal Response Age 2-5 Years</th>
<th>Best Verbal Response Age Less than 2 Years</th>
<th>Best Motor Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>4 Oriented / Converses</td>
<td>5 Appropriate Words/Phrases</td>
<td>5 Smiles/Coos/Cries Appropriately</td>
<td>5 Moves Spontaneously/ Purposefully</td>
</tr>
<tr>
<td>To Speech</td>
<td>3 Disoriented / Converses</td>
<td>4 Inappropriate Words</td>
<td>4 Cries/Is Consolable</td>
<td>4 Localizes Pain/Withdraws to Touch</td>
</tr>
<tr>
<td>To Pain</td>
<td>2 Inappropriate Words</td>
<td>3 Cries/Screams</td>
<td>3 Persistent Screaming/Crying/ Inconsolable</td>
<td>3 Withdraws to Pain</td>
</tr>
<tr>
<td>None</td>
<td>1 Incomprehensible</td>
<td>2 Moans/Grunts to Pain</td>
<td>2 Moans/Grunts to Pain</td>
<td>2 Abnormal Flexion</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Abnormal Extension</td>
</tr>
</tbody>
</table>

**CHILDMREN COMPENSATE BETTER THAN ADULTS**

It is often difficult to predict the severity of illness in a pediatric patient early in an injury or disease process, making it important for EMS providers to understand the compensatory mechanism variations between the adult and child.

Bearing these variations in mind, you should be able to more effectively predict when a sick child becomes a critical child. These variations should be considered in every child encountered in the field.

**BREATHING IS EVERYTHING TO A CHILD... REMEMBER THE BASICS**
Airway Assessment

The No. 1 cause of death in children is hypoxia. Lack of a patent airway or breathing adequacy is the most common reason for development of hypoxia.

Normal respirations in an infant can be irregular and, as a result, respiratory rates should be assessed over a minimum of 30 seconds, but ideally 60 seconds. In adults, we often have a tendency to evaluate respiratory rates for 15 seconds and multiply those rates by 4. The variability of respiration in infants may not produce an accurate rate when only observed for 15 seconds. It is important to note that the variable rate of respiration in infants may include cessation in breathing for up to 20 seconds. Anything greater than 20 seconds should be considered abnormal and will require intervention.

Children rely heavily on rate of respiration to compensate for respiratory difficulty. This is because they are unable to increase the depth of respiration due to the inability of the diaphragm to move farther downward against the compacted abdominal organs. Conversely, adults can increase rate and depth of respiration when they experience respiratory difficulty.

One of the most common techniques for assessing the lungs is to determine lung sounds by auscultation. Auscultating lung sounds in a child ideally should be conducted in a relatively quiet environment and take into consideration that the child has a small and thin chest wall. Auscultate lung sounds in the midaxillary (below the armpits) region to ensure that referred breath sounds (sounds that can be transmitted from one side of the chest to another) are not heard. Hearing referred breath sounds is possible because a thin chest wall is capable of transmitting sounds easily.

In addition to lung sounds, it is imperative to determine the depth of respiration to ensure the child is maintaining an adequate tidal volume. Remember that the work of breathing that was identified in the PAT should be re-evaluated regularly throughout transport to make certain the child has not decompensated.

Airway Anatomy & Physiology

It is important to identify differences between adult and pediatric anatomy and physiology. The anatomical and physiologic variations between adults and children can cause confusion if the EMS provider does not fully understand these differences.

One of the most obvious anatomical differences between an adult and child is the tongue. The pediatric tongue is larger than the adult in relation to the amount of free space in the oropharynx. The large tongue creates a significant probability for airway occlusion and leaves
little room for airway swelling. The size of the tongue is thought to be one explanation for why children are obligate nose-breathers: breathing through the nose is easier because it provides a direct path for airflow without concern for any obstruction that the tongue may cause.

The pediatric trachea is much more pliable and smaller in diameter than the adult and has immature tracheal rings. The increased pliability of the trachea can be troublesome in the pediatric patient because hyperextension or hyperflexion of the neck may lead to complete or partial occlusion of the airway. The small diameter of the trachea allows for only a minimal amount of swelling before significant compromise of airflow occurs.

The pediatric epiglottis tends to be large and is more u-shaped or oblong, making it more difficult to control when attempting intubation. There are a variety of practices related to pediatric intubation, including the preferential use of a straight (Miller) blade versus a curved (McIntosh) blade. The reason for this preference is attributed to the unique shape of the epiglottis: The curved blade fits into the vallecula and indirectly lifts the epiglottis from the glottic opening, whereas the straight blade is inserted under the epiglottis and directly elevates it for visualization of the vocal cords. This allows for better control of the epiglottis. The long epiglottis can easily flop down around the curved blade and cause visual obstruction of the glottis and vocal cords.

The position of the adult larynx is at about the level of the fourth or fifth cervical vertebrae; the pediatric larynx is at about the level of the first or second cervical vertebrae. If the pediatric larynx were lower, children would aspirate food into the trachea as they swallow. This is an important anatomical airway consideration, since the higher larynx is more anterior.

The mainstem bronchi in young children have less angle than in adults. As a result, aspiration can occur in either the left or right mainstem bronchi. As children grow, an increase in chest diameter causes the angle of the left bronchus to increase as well.

**Pulse Oximetry**

The use of pulse oximetry in children is highly recommended. Pulse oximetry readings can be used to monitor and document saturation readings over time and to make a possible correlation to improvements after interventions or worsening of the patient's condition. Caution should be taken when pulse oximetry is used for anything other than trending patient compensation or response to therapy.

A pulse oximetry reading of greater than 94% is generally adequate. If a child cannot maintain saturations above 94% on room air, he is in significant distress and will require supplemental oxygenation. If the saturations stay below 90% on a non-rebreather mask, this child is not
getting enough oxygen and will require assisted ventilations. EMS providers must remember that a child may still be sick despite adequate pulse oximetry readings. Treat the patient, not the monitor. If the child looks sick, he likely is sick and will require intervention.

A simple and quick pulse oximeter reading immediately yields information regarding oxygenation status, but also provides an indication of peripheral perfusion. A normal pulse oximeter reading is another clinical indicator in confirming an adequate peripheral perfusion status. If the pulse oximeter reading is abnormal with the probe attached to a peripheral site, consider moving the probe to a more central location like the earlobe or bridge of the nose. A poor peripheral SpO2 reading with a good central oximetry reading is most likely a result of poor perfusion rather than respiratory insufficiency. The exception to this rule is the child with breathing abnormalities.

The common denominator for unexpected deaths in children is hypoxia. This encompasses a very diverse group of illnesses, including infectious diseases, choking, drowning, heart disease and pulmonary compromise. Unlike adults, children typically have a strong cardiovascular system and subsequently maintain cardiovascular function until they become extremely hypoxic. A child's metabolism is twice that of an adult's and thus requires much higher quantities of oxygen than the adult's. The body's source for oxygen comes from the pulmonary system, so it stands to reason that children with pulmonary problems will ultimately progress to cardiovascular compromise and eventually to death.

When assessing a child with respiratory compromise, it is important to reduce, or at least not increase, the child's anxiety. Anxiety increases the workload of breathing, which may in turn exacerbate the pulmonary event. Simply keeping the child who does not present with immediate life-threats in the mother's, father's or primary caregiver's lap may be enough to reduce anxiety.

Once pulmonary compromise is identified, determine a plan of emergency care. If the airway is intact, and there is no obstruction, the child may simply need coaching to take a deep breath to improve ventilatory status. Although there are numerous methods for eliciting deep breaths in children, these methods seem to work fairly well.

- Most children are familiar with the fairy tale about the three little pigs and the big, bad wolf. Use that story and have the child "huff and puff" like the wolf. This is an easy way to coach them to take a breath and is also helpful when trying to auscultate lung sounds.
• Another technique is to have them "blow out" a penlight. When deeper inspirations are needed, ask the child to "blow harder."

• Assuming the child is old enough to not be at risk for swallowing a balloon, ask him to blow up a balloon while you auscultate his lungs. This works well, and the child will have the balloon to play with during his stay in the emergency department.

Capnography

Capnography is most useful when quantitative and graphic readings are available, as in continuous waveform capnography. This form of capnography allows for continuous airway and ventilation monitoring. It has been found to be especially useful during CPR. At the onset of cardiac arrest, carbon dioxide levels drop far and fast. Despite cardiac arrest, the carbon dioxide levels begin to rise with effective CPR; even more amazingly, they return to near-normal levels with a return of spontaneous circulation (ROSC). Clinical studies have proven that end-tidal CO2 levels have been predictive of cardiac output and coronary perfusion pressure (CPP). As such, it can be deduced that since ETCO2 can determine cardiac output and CPP, it can also effectively measure compression effectiveness during CPR.

In the prehospital environment, one study suggested that children are at a much greater risk for accidental endotracheal tube dislodgement. It may be easier to identify a dislodged tube in children than in adults because of their sensitivity to hypoxia, but it may still be difficult. As a result of this statistic, there have been recommendations to make the use of continuous waveform capnography a staple of assessment in pediatric airway management instead of an optional tool. It is not a sin to have a misplaced endotracheal tube; the sin is not identifying it.

Circulatory Assessment

Pediatric heart rates are variable. Pulse points are no different in children than they are in adults, but there are some differences in the way these pulses are evaluated. The small anatomy of children, coupled with the lower palpable magnitude of pediatric cardiac output, makes palpation of pulses in certain anatomical regions impossible, or extremely difficult. In small children, it is recommended that peripheral pulses be obtained at the brachial artery (inside of the bicep) and central pulses be obtained at either the femoral or carotid arteries. If no pulses can be palpated, consider auscultating an apical pulse using a stethoscope. If a heartbeat can be heard, the child has a pulse; however, the presence of a pulse does not automatically indicate adequate perfusion.

Capillary refill time is typically quite accurate in children and considered to be reliable in most cases. Healthy children do not have the vascular disease adults may; therefore, capillary blood
flow is very responsive and typically refills normally within 2 to 3 seconds. Just as in the adult patient, environmental factors like cold ambient temperatures can prolong capillary refill times. For this reason, capillary refill time should be assessed closer to the core in areas like the kneecap or forearm. If a cold environmental temperature is a concern during assessment, find a warm area on the body to assess for capillary refill.

**Cardiovascular Anatomy and Physiology**

Although the pediatric and adult hearts share identical anatomy, several important distinctions need to be made between the adult and pediatric cardiovascular systems.

First, the adult heart increases its stroke volume by increasing inotropy (strengthening contractions) and chronotropy (increasing heart rate). In contrast, the pediatric heart can only increase chronotropy in an attempt to increase stroke volume. The pediatric heart has low compliance as it relates to volume; therefore, it cannot compensate well by increasing stroke volume. Consequently, heart rate should be seen as a significant clinical marker when monitoring cardiac output in the fetus, neonate and pediatric patient. When the pediatric patient becomes bradycardic, it should be assumed that cardiac output has been drastically reduced. Bradycardia is most commonly caused by hypoxia. Bradycardia may be an early sign of hypoxia in the neonate; however, it is an ominous sign of severe hypoxia in the infant and child.

**RED FLAGS IN PEDIATRIC ASSESSMENT**

There are several clinical signs that must be considered when assessing a sick child. If any of the following signs are present, aggressive intervention should be employed as quickly as possible to prevent the child from going into cardiopulmonary arrest.

- Respiratory rate greater than 60
- Significant hemorrhage
- Respiratory distress or failure
- Significant trauma
- Nasal flaring
- Alterations in mentation
- Uncorrected noisy respiration
• Seizures
• Cyanosis
• Fever or history of fever with a global rash
• Mottling
• Heart rate greater than 180 bpm
• Pallor
• Heart rate less than 60

SYNCOPE VERSUS SEIZURES

Lay people and EMS providers alike may have difficulty differentiating a syncopal episode from a seizure in the pediatric population. When responding to the scene of an unresponsive child, given the high stress associated with pediatric medical emergencies, obtaining a good history of events can be difficult.

Incontinence is an uncommon finding in a syncopal episode, but is common in seizure activity. It is important to note, however, that this finding is not reliable in a diaper-dependent child, since it is difficult to determine the time the diaper was soiled in relation to the physiologic event. Syncope does not present with any history of tonic-clonic activity and typically occurs with generalized symptomatology. In contrast, a seizure patient often has a recent history of generalized tonic-clonic activity or localized focal motor activity.

In addition to physical assessment findings, determining the duration of loss of consciousness may help to determine if the etiology is related to syncope or seizures. In a syncopal event, there is generally a relatively short duration (less than five minutes) of unconsciousness, in contrast to a relatively longer duration (greater than five minutes) in a seizure.

FEAR FACTOR

Next time you need to calm a toddler for an examination, try running through a practice exam on a stuffed animal the child is holding or on an older sibling or parent. During the exam, search for characters the child can relate to (such as Disney characters). Children get involved in the game and their stress reduces.

It can be difficult to gain the cooperation of toddlers undergoing an examination. It may be helpful to ask children if they are ticklish as you gently tickle their ribs, axilla or neck. Explain
that the examination may tickle the same way, so they expect to feel something. Talk to the child throughout your exam, and tell them it is okay to giggle but not to wiggle. This may sound cheesy, but it actually works.

MANAGING THE PEDIATRIC PATIENT

PREHOSPITAL PEDIATRIC VENTILATORY MANAGEMENT

It is often believed that ventilating a child can be well accomplished in the field using a pediatric bag-valve-mask device. While it is true that a pediatric BVM can be used to ventilate a sick child, it is not the optimal device.

In a study published in the journal Respiratory Care, experienced respiratory therapists were asked to ventilate a pediatric test lung to determine their ability to identify changes in ventilatory compliance. While these experienced practitioners recognized a change in compliance 65% of the time, they could not effectively identify the overall tidal volume delivered to the child. The recommendation from this study was that a standard BVM is not the optimal tool for managing a pediatric airway.

The optimal ventilation device is an anesthesia bag with a manometer attached to measure peak inspiratory pressures (PIP). Using this device will allow you to actually monitor real pressures delivered to the child’s airway to ensure that the tidal volume delivered is on target with the child’s physiologic demands. There is a significant body of evidence suggesting that over inflation of the lungs have untoward effects on a child’s morbidity and mortality rates.

It is not recommended that EMS systems transition pediatric ventilatory management to anesthesia bags, but we must remember the potential for poor ventilation in the pediatric population. If a seasoned respiratory therapist (who ventilates children on a more regular basis) has difficulty in determining ventilatory compliance, all EMS providers should take pause when ventilating children with a BVM. Be sure you are cognizant of the risks associated with bag-valve ventilation.

The MOANS mnemonic is used to identify a patient who may be difficult to ventilate with a bag-valve-mask device.

MOANS

• Mask seal
• Obesity/Obstruction
• Age (greater than 55)
• No teeth

• Stiffness

Mask seal

Successful bag-mask ventilation is dependent on just two factors: mask seal and a patent upper airway. A recessed chin, as seen in some congenital malformations, may make sealing the mask difficult. In the prehospital setting, when prolonged ventilation is necessary, a mask seal may become loose and ineffective due to muscle fatigue in the EMS practitioner's hands. Constantly monitor the mask seal to ensure there is no air leakage.

Obesity/Obstruction

Obstruction is a consideration in pediatric patients. Obstruction of the upper airway may be caused by epiglottitis, angioedema or peritonsillar abscesses and can make the child's airway difficult to establish and manage.

Age

Age is not a factor in pediatric airway management.

No teeth

It is extremely difficult to create a mask seal in edentulous (toothless) patients due to the lack of a platform for the mask to rest upon to create an effective seal.

Stiff lungs

Stiff lungs require higher airway pressures to ventilate, and may result in difficulty in performing positive pressure ventilation. Bronchospastic conditions, such as asthma, are associated with higher airway resistance and may lead to more difficult ventilation states. Disease processes that create either compliance or higher airway resistance may create a situation in which increased ventilation pressures are necessary to generate adequate oxygen saturation.

YOU CANNOT REMEMBER NORMAL WEIGHTS, RESPIRATORY RATES, BLOOD PRESSURES, HEART RATES, AND CALCULATE DRUG DOSES IN YOUR HEAD SO DON'T TRY....

There are several factors that can impact the potential for clinical errors in managing a sick child, including unique drug doses (compared to traditional adult doses), choice of equipment size, and fluid and ventilatory volumes necessary to a successful resuscitation effort. Combine
these factors with the high stress environment and impaired cognitive ability in such a scenario and the risk for error is high. It is therefore recommended that a length-based tape or the like be used to ensure that the human error factor is eliminated, or at least substantially mitigated.

<table>
<thead>
<tr>
<th>Age*</th>
<th>Typical Systolic BP (Age x 2) + 90</th>
<th>Lower Limits of SBP (Age x 2) + 70</th>
<th>Awake Pulse (Range)</th>
<th>Sleeping Pulse</th>
<th>Resp. Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neo to 3 months</td>
<td>90</td>
<td>70</td>
<td>140 (85-205)</td>
<td>80-160</td>
<td>30-60</td>
</tr>
<tr>
<td>3 mos.to 2 yrs.</td>
<td>90-92</td>
<td>70-72</td>
<td>130 (100-190)</td>
<td>75-160</td>
<td>24-40</td>
</tr>
<tr>
<td>2 to 10 yrs.</td>
<td>94-110</td>
<td>74-90</td>
<td>80 (60-140)</td>
<td>60-90</td>
<td>18-30</td>
</tr>
<tr>
<td>Over 10 yrs.</td>
<td>Over 110</td>
<td>90</td>
<td>75 (60-100)</td>
<td>50-90</td>
<td>12-20</td>
</tr>
</tbody>
</table>

A recent study found that medication errors could be reduced by 25% through the use of a length-based tool. In a recent policy statement by the American Academy of Pediatrics Committee on Pediatric Emergency Medicine, the authors suggest that medication errors are still a threat with length-based tools, since the dosages noted on these tools are documented in milligrams rather than milliliters, which could contribute to calculation errors in the conversion of mg to mL. Standardizing drug concentrations and developing a conversion chart in the prehospital environment may be the only way short of an electronic conversion tool to prevent these errors.

MORE SUCCESSFUL IV STICKS

Instead of applying the usual thin elastic band to the upper arm for an intravenous stick, consider using a blood pressure cuff inflated to between 20–35 mmHg. This has several advantages:
• The pressure is measurable, and the risk of "blowout" from over-dilated, fragile veins is avoided.

• The patient is more comfortable, and there is no need to tighten, "pump" the fist or flick the skin.

• If the child is sick enough to require an IV, a BP should be recorded. EMS providers frequently neglect pediatric blood pressure checks, with the belief that they are not necessary in a child with an adequate peripheral pulse. This is only true in the child under 3 years of age. In a patient 3 years or older, blood pressure is a necessary and valuable assessment tool.

In a critically ill pediatric patient, remember that an EZ IO is available and provides for rapid vascular access. Our Aurora South Market Protocol is:

**Indications:**

1. *May be used for patients in Cardiac and/or Respiratory Arrest without an IV attempt, but generally should be used only if IV access not able to be obtained after at least 2 IV attempts.*

2. *In conscious patients in immediate life or limb threat where IV attempts unsuccessful.*

3. *In conscious patients with immediate need for fluids or medications and able to give IO lidocaine. (Paramedic only)*

4. *In unconscious patients with immediate need for fluids or medications.*

**Pediatrics**

• *Proximal tibia*

• *Distal tibia*

(Note: Proximal humerus can be used in pediatric patients when the landmarks can clearly be identified)

A critically ill pediatric patient may need IV/IO fluids. Our Aurora South Market Protocol is:

1. *If evidence of shock, administer IV fluid 20 mL/kg IV/IO. May repeat times 2 if necessary up to maximum of 60 mL/kg. Reassess patient after each bolus.*
Structural Variations

The bones in young children are not completely calcified and tend to be flexible. Children's ribs are more horizontal than they are rounded, as seen in adults. The horizontal nature of the ribs provides for little leverage to increase the anterior and posterior diameter of the chest. This does not facilitate the degree of lift that is necessary to increase the volume of air within the chest when it is needed most. In addition, younger children have less-developed accessory muscles, making it more difficult to increase the strength and depth of ventilations.

When looking at a chest x-ray, it is easy to appreciate the relative amount of space the heart occupies in the chest of a child. The relationship between heart size and thoracic cavity size helps to explain why children have less pulmonary reserve than adults. Children have less ability to increase volume within the lungs, because the lungs are only capable of expanding to the degree there is space to expand; the heart occupies much of the thoracic cavity.

The pediatric abdominal cavity is small and has large organs compressed within it. A significant problem with the overcrowding that occurs in the abdomen is that it has a negative effect on the compensatory mechanisms of respiration in children. Children rely heavily on rate of respiration to compensate for respiratory difficulty because they are unable to increase the depth of respiration due to the inability of the diaphragm to move farther downward against the compacted abdomen. Conversely, adults can increase rate and depth of respiration when they experience respiratory difficulty.

Physiologic Variations

One of the first things to remember when dealing with pediatric patients is that the pediatric body surface area-to-volume ratio is four times that of an adult, while its heat production is only one-and-a-half times as high. This variation predisposes the pediatric patient to a greater risk for accidental hypothermia that can easily result in significant physiologic compromise. Additionally, the pediatric patient's muscle tone may be immature and, as a result, cannot effectively induce muscular shivering as an effective mechanism for preserving heat to the body core. Compounding this heat production and maintenance concern is that these patients generally have smaller amounts of adipose tissue, which contributes to poor insulation and additional difficulty in maintaining core body temperature. While we must expose the child to facilitate a complete head-to-toe exam, we MUST then remember to protect the child from losing body heat. This can be accomplished by covering with blankets, keeping the ambulance warm and removing any wet linen or clothing from around the child.

Infants and small children are also at a greater risk for developing acute hypoglycemia because their livers are underdeveloped and they typically have decreased glycogen stores. The
decreased glycogen stores, coupled with an increased metabolic rate resulting in the use of large quantities of serum glucose, make the pediatric patient prone to hypoglycemia. Stress may induce hypoglycemia in the pediatric patient. A bedside glucose level should be evaluated in all infants regardless of the diagnosis.

**CHILDREN DON’T HAVE LESS PAIN THAN ADULTS**

There are many misconceptions surrounding pain interpretation in pediatric patients. Recent science has concentrated on determining the reality of pain perception in children. A significant body of research suggests that children as young as six months have memory of painful experiences. Normal physiology supports this theory, since the limbic system and diencephalon, which are responsible for memory, are well developed in the neonate. It has been proven that unrelieved pain in children can have significant physiologic and psychologic consequences, which can include changes in activity level, appetite and sleep, and may impact hemodynamic stability.

Children have the same number and density of nociceptive nerve fibers (pain receptors) as adults, and can therefore experience pain in the same way. In addition, the neurochemical mediators that are often involved in the pain response are developed and functional. Finally, although children have a larger number of unmyelinated fibers, the overall distance that the nerve impulse needs to travel is significantly shorter than that of an adult, and pain is experienced. Unmyelinated fibers do not contain a myelin sheath, which is a cellular structure that surrounds a nerve fiber for the purpose of insulting the nerve to ensure that electrical impulses are contained and can move quickly across the nerve without interruption.
Summary

Some children, regardless of what is done for them, will get sick and die. Fortunately, this is more rare than regular. An EMS provider who appropriately assesses a sick child with a potential to survive will be able to identify life-threatening conditions and manage those conditions. The most common cause of pediatric death is hypoxia. A hypoxic child without proper intervention will ultimately experience cardiovascular collapse and eventually death.

Most healthy children have no difficulty in maintaining normal cardiovascular function until and unless they become extremely hypoxic. EMS providers must understand that the most effective management processes require an understanding of why children present in the way they do. If an assessment is not thorough and accurate, a child may continue to deteriorate. Assessment is the key to pediatric management.