Emergency medicine providers should be comfortable assessing and treating pediatric patients from the newly born through adolescence. Of the 124 million annual U.S. emergency visits, 23 million are for children younger than 15 years. Twenty percent of children have at least one emergency department visit per year. The age group with the highest emergency department use per capita is infants, with 85.5 visits per 100 infants. Although some hospitals have separate pediatric emergency departments, most pediatric patients are seen in general emergency departments. Several recent surveys found that more than 80% of pediatric patients are seen in general emergency departments. Therefore, all emergency providers need to be prepared to provide definitive treatment for many pediatric illnesses and injuries and to provide initial stabilization and treatment to critically ill and injured pediatric patients.

An understanding of the anatomic, physiologic, developmental, and behavioral differences between pediatric and adult patients is critical to appropriate treatment of many pediatric emergencies. In addition to these differences, caring for the pediatric patient also involves the parents or other caregivers. This chapter reviews these differences and describes approaches to evaluation and treatment of pediatric patients.

**PERSPECTIVE**

**DISTINGUISHING PRINCIPLES OF DISEASE**

**Pathophysiology**

Different patterns of illness and injury are seen in children because of their unique physiologic and anatomic characteristics. Illness and injury patterns not only differ between pediatric and adult patients but also vary in children of different ages. Understanding and anticipating these differences will help the emergency provider in evaluating and treating patients of all ages. Besides the obvious cognitive and behavioral development seen as children grow, temperature regulation, airway anatomy and physiology, cardiovascular physiology, immune function, and the musculoskeletal system all change with age. Furthermore, pediatric patients may present to the emergency department with previously undiagnosed congenital anomalies. Drug dosing and choice of medications depend on size and other physiologic considerations.

In most patients, the first step in assessment is a review of vital signs. Normal ranges for vital signs vary significantly by age. Early recognition of abnormal vital signs will help the emergency provider detect physiologic decompensation in its earliest stages. Normal vital signs by age are listed in Table 166-1. Abnormal vital signs should be repeated, and persistently abnormal vital signs should not be ignored.

**Temperature Regulation**

Infants and young children have a large surface area-to-mass ratio and lose more heat to the environment than adolescents and adults. Maintenance of a stable body temperature can be a significant metabolic demand in young infants, especially those stressed by injury or illness. Every effort should be made to maintain a neutral thermal environment. Patients can be exposed briefly for interventions and examinations but should be covered as soon as possible to avoid excessive heat loss. Critically ill young infants should be placed under radiant warmers. Overhead warming lights can be useful for older infants and children requiring prolonged exposure for resuscitation and procedures.

**Airway**

The pediatric airway differs in a number of ways from an adult airway. Numerous characteristics of the pediatric airway predispose to obstruction. Infants and young children have relatively large tongues, which may lead to airway obstruction during seizures or periods of altered mental status. Use of nasopharyngeal airways can be helpful in bypassing obstruction due to a relatively large tongue. The small airways of children are more easily obstructed with secretions. In addition, young infants preferentially breathe through their noses and can have significant respiratory distress from nasal secretions. For these reasons, airway suctioning can dramatically diminish an infant’s work of breathing. Infants and young children also have large occiputs, causing neck flexion and potential airway obstruction in the supine position. A shoulder roll can be used to properly position young patients; it may significantly decrease respiratory distress and improve intubating conditions (Fig. 166-1).

**Cardiovascular**

Healthy children have compensatory mechanisms that can support blood pressure even when cardiac output is decreasing. Children have the ability to increase their heart rate and peripherally vasoconstrict to shunt blood centrally. Hypotension is a late finding of shock in previously healthy children, and intervention should occur before the onset of hypotension. The earliest sign of cardiovascular compromise in most patients is tachycardia. Unfortunately, tachycardia is nonspecific and may be due to fever, pain, or anxiety. Repeated assessment of the heart rate can be helpful. Unexplained tachycardia in a calm or sleeping child is concerning.
The quality of the pulse is also helpful in assessing patients. A thready pulse associated with tachycardia should be considered to be shock until it is proved otherwise. Bradycardia in ill children is especially ominous and may signal impending cardiac arrest.

**Musculoskeletal**

Growing children have musculoskeletal injury patterns different from those of adults. The weakest part of a growing child’s bone is the physis, or growth plate, leading to a propensity to fracture. Physeal injuries should be considered in children even with normal radiographs. Treatment of fractures in children takes future growth potential into consideration. Certain physeal injuries can lead to long-term growth disturbance if not treated appropriately. At the same time, growing children have more potential for bone remodeling and greater degrees of angulation can be accepted for certain fractures. Ligaments are strong relative to the immature bone, so children have an increased propensity to fracture bones rather than to sprain ligaments.

**Immunologic**

Young infants are at increased risk of serious bacterial infections because of their immature immune system. Febrile infants younger than 1 month are an especially high-risk group and have an approximately 10% rate of serious bacterial infection. For this reason, the evaluation of infants with fever differs from the evaluation of older children and adults, and the workup varies by the age and vaccination status of the infant.

**Pharmacologic**

Pediatric patients are particularly prone to medication errors for multiple reasons, including the fact that medications for children are calculated using weight-based dosing with attention to the adult maximum medication dose. Most calculation-based dosing errors occur in pediatric patients. Suggested safeguards include pharmacy review of medication orders, computerized order entry and use of templated order forms, resuscitation calculators, and length-based resuscitation tapes. One easily remedied potential error is the inadvertent calculation of a drug dose on the basis of weight in pounds, not kilograms, leading to a more than twofold overdose. For this reason, emergency department scales should be programmed to report weight in kilograms, not pounds, and weight in pounds should not be written in the medical chart.

In addition to potential dosing errors, certain frequently used medications should not be given to young children. For example, ceftriaxone is not recommended in the first month of life because it may cause bilirubin encephalopathy. Use of pediatric-specific drug references can help providers avoid medication errors.

**Developmental**

Assessment of pediatric patients requires some understanding of normal developmental milestones. Table 166-2 lists basic developmental milestones in the first 2 years of life. There will be variation in the rate at which children develop. Therefore, the parent’s report of the child’s developmental history and normal behavior is extremely important.

**Young Infants**

Infants younger than 2 months are especially challenging to assess because they have limited behavioral cues. They may not make eye contact or have a social smile. Normal behavior includes sleeping, crying, quiet alert time, feeding, and stooling. A change in any of these activities may indicate serious disease. Increased sleeping or crying or decreased interest in feeding may be the early sign of serious disease and should be investigated.

**Infants (<12 months of age)**

By 2 months of age, infants develop a social smile and track objects held near their faces. Lack of interaction with the parents is

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**Table 166-1 Normal Pediatric Vital Signs**

<table>
<thead>
<tr>
<th>AGE (yr)</th>
<th>RESPIRATORY RATE (breaths/min)</th>
<th>HEART RATE (beats/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>30-60</td>
<td>100-160</td>
</tr>
<tr>
<td>1-2</td>
<td>24-40</td>
<td>90-150</td>
</tr>
<tr>
<td>2-5</td>
<td>22-34</td>
<td>80-140</td>
</tr>
<tr>
<td>6-12</td>
<td>18-30</td>
<td>70-120</td>
</tr>
<tr>
<td>&gt;12</td>
<td>12-16</td>
<td>60-100</td>
</tr>
</tbody>
</table>

Lower Limits of Systolic Blood Pressure*

- 0-28 days: 60 mm Hg
- 1-12 months: 70 mm Hg
- 1-10 years: 70 mm Hg + (2 x age in years)


---

**Figure 166-1.** Infant with neck in flexed position and after placement of a shoulder roll. (From Santillanes G, Gausche-Hill M: Pediatric airway management. Emerg Med Clin North Am 26:961-975, 2008.)
Some toddlers are fearful and unable to cooperate, whereas others are curious and cooperate more easily with the examination. When the patient is stable, it can be helpful to begin the encounter standing or sitting at a distance from the child while taking the history in a limited way, such as pointing to the location of pain. Toddlers vary in their response to physical examination. Some toddlers are fearful and unable to cooperate, whereas others are confident and cooperate easily.

**Table 166-2 Developmental Milestones in Children Younger Than 2 Years**

<table>
<thead>
<tr>
<th>AGE</th>
<th>GROSS MOTOR</th>
<th>VISUAL-MOTOR AND PROBLEM SOLVING</th>
<th>LANGUAGE, SOCIAL, AND ADAPTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mo</td>
<td>Raises head slightly from prone position, makes crawling movements</td>
<td>Birth: visually fixes</td>
<td>Alerts to sound</td>
</tr>
<tr>
<td></td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>Regards face</td>
</tr>
<tr>
<td>2 mo</td>
<td>Holds head in midline, lifts chest off table</td>
<td>No longer clenches fist tightly, follows object past midline</td>
<td>Smiles socially (after being stroked or talked to)</td>
</tr>
<tr>
<td></td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>Smiles socially (after being stroked or talked to)</td>
<td>Recognizes parent</td>
</tr>
<tr>
<td>3 mo</td>
<td>Supports on forearms in prone position, holds head up steadily</td>
<td>Holds hands open at rest, follows in circular fashion, responds to visual threat</td>
<td>Coos (produces long vowel sounds in musical fashion)</td>
</tr>
<tr>
<td></td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>Coos (produces long vowel sounds in musical fashion)</td>
<td>Reaches for familiar people or objects, anticipates feeding</td>
</tr>
<tr>
<td>4 mo</td>
<td>Rolls front to back, supports on wrists and shifts weight</td>
<td>Reaches with arms in unison, brings hands to environment midline</td>
<td>Laughs, orients to voice</td>
</tr>
<tr>
<td></td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>Laughs, orients to voice</td>
<td>Enjoys looking around</td>
</tr>
<tr>
<td>5 mo</td>
<td>Rolls back to front, sits supported</td>
<td>Transfers objects</td>
<td>Says “ah-goo,” orients to bell (localizes laterally)</td>
</tr>
<tr>
<td></td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>Transfers objects</td>
<td>Babbles</td>
</tr>
<tr>
<td>6 mo</td>
<td>Sits unsupported, puts feet in mouth in supine position</td>
<td>Unilateral reach, uses raking grasp</td>
<td>Recognizes strangers</td>
</tr>
<tr>
<td></td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>Unilateral reach, uses raking grasp</td>
<td>Orients to bell (localizes indirectly)</td>
</tr>
<tr>
<td>7 mo</td>
<td>Creeps</td>
<td>7-8 mo: inspects objects</td>
<td>“Dada” indiscriminately</td>
</tr>
<tr>
<td></td>
<td>1 mo: has tight grasp, follows to midline</td>
<td>7-8 mo: inspects objects</td>
<td></td>
</tr>
<tr>
<td>8 mo</td>
<td>Comes to sit, crawls</td>
<td>7-9 mo: finger-feeds</td>
<td></td>
</tr>
<tr>
<td>9 mo</td>
<td>2-step commands</td>
<td>Uses pincer grasp, probes with forefinger, gestures, waves bye-bye, holds bottle, throws objects</td>
<td>“Mama” indiscriminately, understands “no”</td>
</tr>
<tr>
<td></td>
<td>1 mo: follows 1-step command without gesture</td>
<td>“Mama” indiscriminately, understands “no”</td>
<td>Starts to explore environment, plays gesture games (e.g., patty cake)</td>
</tr>
<tr>
<td></td>
<td>1 mo: uses 3 words</td>
<td>10 mo: “Dada” and “Mama” discriminately, orients to bell (directly)</td>
<td>11 mo: “Dada” and “Mama,” follows 1-step command with gesture</td>
</tr>
<tr>
<td>12 mo</td>
<td>Walks alone</td>
<td>Uses mature pincer grasp, releases voluntarily, marks paper with pencil</td>
<td>Uses 2 words other than “Dada” and “Mama,” immature jargoning (runs several unintelligible words together)</td>
</tr>
<tr>
<td></td>
<td>1 mo: follows 1-step command without gesture</td>
<td>“Dada” indiscriminately</td>
<td>Imitates actions, comes when called, cooperates with dressing</td>
</tr>
<tr>
<td>15 mo</td>
<td>Creeps up stairs, walks backward</td>
<td>Scribbles in imitation, builds tower of 2 blocks in imitation</td>
<td>Uses 2 words other than “Dada” and “Mama,” immature jargoning (runs several unintelligible words together)</td>
</tr>
<tr>
<td></td>
<td>1 mo: follows 1-step command without gesture</td>
<td>“Dada” indiscriminately</td>
<td>Imitates actions, comes when called, cooperates with dressing</td>
</tr>
<tr>
<td>18 mo</td>
<td>Runs, throws objects from standing without falling</td>
<td>Scribbles spontaneously, builds tower of 3 blocks, plays in company of other children</td>
<td>Uses 2-word combinations</td>
</tr>
<tr>
<td></td>
<td>1 mo: follows 1-step command without gesture</td>
<td>“Dada” indiscriminately</td>
<td>Copies parent in tasks (sweeping, dusting), turns 2-3 pages at a time</td>
</tr>
<tr>
<td>21 mo</td>
<td>Squats in play, goes up stairs</td>
<td>Builds tower of 5 blocks</td>
<td>Uses 2-word combinations</td>
</tr>
<tr>
<td></td>
<td>1 mo: follows 1-step command without gesture</td>
<td>Builds tower of 5 blocks</td>
<td>Copies parent in tasks (sweeping, dusting), turns 2-3 pages at a time</td>
</tr>
<tr>
<td>24 mo</td>
<td>Walks up and down steps without help</td>
<td>Imitates stroke with pencil, builds tower of 7 blocks, turns pages 1 at a time, removes shoes and pants</td>
<td>Uses pronouns (I, you, me appropriately), follows 2-step commands</td>
</tr>
<tr>
<td></td>
<td>1 mo: follows 1-step command without gesture</td>
<td>Imitates stroke with pencil, builds tower of 7 blocks, turns pages 1 at a time, removes shoes and pants</td>
<td>Parallel play</td>
</tr>
</tbody>
</table>


Concerning the pediatric patient, after 6 months, infants may develop significant stranger anxiety, which can make the physical examination challenging. Whenever possible, examination of the infant in the parent’s lap will lead to less anxiety of the patient and may facilitate the physical examination. Brightly colored toys or toys with lights or sounds serve to distract the infant and may be useful in keeping the patient calm.

**Preschoolers (3- to 5-year-olds)**

Preschool-age children have increasing language skills. Like toddlers, their receptive language skills exceed their expressive language skills, and they often understand more than is realized. Preschoolers should be included in the conversation when possible. Providers should be cautious about talking to parents about procedures or diagnoses in front of the preschool child even if the child seems not to be paying attention or not to understand. Like
toddlers, preschool children vary greatly in their cooperation with the physical examination. Providing limited options, such as sitting with the parent or on the gurney or choosing which ear should be examined first, may improve cooperation. Distraction with questions or stories can facilitate the physical examination. Simple, concrete explanations of procedures are appropriate immediately before and during the procedure. Preschool children may perceive illness or painful procedures as punishment for their actions, making simple explanations of what is occurring and why even more important.

School-Age Children

At least some questions during the history should be directed at the school-age child. Some older school-age children will be able to provide much of the history themselves. School-age children are often cooperative with the examination but may regress when they are frightened or in pain. School-age children become increasingly modest, and attempts should be made to provide privacy. School-age children may attempt to negotiate or stall when painful or unpleasant examinations or procedures are planned. Honest and firm but reassuring explanations of what will happen are important. Appropriate concrete explanations include the sequence of events and what physical sensations the patient will experience. Preparation for procedures will give children some sense of control. Timing the explanation shortly before the procedure may decrease anxiety. School-age children may perseverate and become extremely anxious if there is a long delay between the explanation and the procedure.

Adolescents

Adolescents increasingly want independence from their parents but may regress in times of stress. Adolescents will be able to provide much if not all of the history. However, it is important to elicit the concerns of both the adolescent and the parent and to ensure that both understand the diagnosis and plan. The adolescent should be given a chance to speak to the provider without the parent in the room. Any sensitive questions, such as drug use and sexual activity, should be asked privately. Adolescents can generally be examined in a manner similar to adults. They are often extremely modest, and attempts should be made to preserve privacy with private rooms when possible and exposure of only the body part being examined. Adolescents may want the parent present during the physical examination or may prefer that the parent stay outside of the room.

Evaluation

Triage

Triage serves to identify patients requiring immediate care, to prioritize patients waiting to be seen, and to ensure that patients are treated in the most appropriate area of the emergency department. Pediatric-specific triage systems are important to avoid overtriage and undertriage of children. Application of adult-specific vital signs to children may lead to inappropriate triage level classification. In addition, signs and symptoms of serious illness may be subtle in infants and very young children.

Triage systems with pediatric modifications include the Emergency Severity Index, the pediatric Canadian Triage and Acuity Scale, the Manchester Triage System, and the Australasian Triage Scale. All of these systems are five-level triage systems. In five-level triage systems, level 1 patients require immediate intervention. Level 2 patients are emergent and should be seen within 10 to 15 minutes. Level 3 patients are considered urgent and should be seen within 30 to 60 minutes, depending on the triage system. Level 4 and level 5 are thought to be stable patients. The Emergency Severity Index classifies patients by acuity and number of resources expected to be required. A flowchart specific to pediatric patients with fever has been added. In the Canadian Triage and Acuity Scale, specific criteria for various presenting complaints are used to assign triage levels. The pediatric modification includes pediatric-specific presenting complaints and determination of acuity by use of pediatric-specific vital signs. The Manchester Triage System contains flowcharts based on presenting complaint, with some pediatric-specific flowcharts. The Australasian Triage Scale is mostly a general triage scale but has several pediatric-specific criteria.

No triage system is clearly demonstrated to be superior, and data on reliability and validity are limited for all triage systems. The Emergency Severity Index, the Manchester Triage System, and the pediatric Canadian Triage and Acuity Scale have been demonstrated to be valid in pediatric patients. Reliability is good for the Manchester Triage System and moderate for the Emergency Severity Index and pediatric Canadian Triage and Acuity Scale. The Australasian Triage Scale appears to have lower reliability than the other triage systems.

History

In critically ill or injured patients, the SAMPLE history can be used as a way to quickly obtain a focused history (Box 166-1). The SAMPLE history reminds providers to ask for Signs and symptoms, Allergies, Medications, Past medical history, Last meal, and Events surrounding the illness or injury.

A more detailed history will be guided by the patient’s complaint. In infants and very young children, the entire history will be obtained from the parent. Although the parent’s concerns should be seriously considered, the history provided by the parent may be unreliable in cases of abuse and neglect. Furthermore, in cases of injury, the event may not have been witnessed, and details may not be available. In preverbal children, symptoms will be inferred by the parent on the basis of the child’s behavior. Parents are often very perceptive and may notice subtle changes that are not immediately obvious to the provider performing a relatively brief assessment. Therefore, parental report of symptoms should not be disregarded.

Additional questions may be indicated in children of different ages. In neonates, pregnancy and birth history are important. In infants and toddlers, urine output, quantified in number of wet diapers, can be helpful in determining the hydration status. This can be especially helpful in breast-feeding newborns, whose intake is difficult to quantify. Vaccination status is important in infants and children presenting with symptoms such as fever and rash. Drug and alcohol use as well as sexual history become important in adolescents who have increased risk-taking behaviors.
Pediatric Assessment Triangle

Rapid recognition of the critically ill child or the child at risk for rapid decompensation is a critical skill for the emergency medicine provider. One tool that has been developed to assist providers in quickly assessing children is the pediatric assessment triangle (PAT) (Fig. 166-2).\(^\text{15,16}\) It is an orderly approach that helps clinicians formulate an initial impression of the overall status of the child from the door of the examination room. The three components of the PAT are appearance, work of breathing, and circulation. On the basis of the initial PAT, the clinician is able to rapidly distinguish the “sick” from “well” child. Table 166-3 summarizes the findings that may be noted on each of the three arms of the triangle, and Table 166-4 summarizes the interpretation of the triangle.

### Table 166-3 Pediatric Assessment Triangle Findings

<table>
<thead>
<tr>
<th>APPEARANCE</th>
<th>WORK OF BREATHING</th>
<th>CIRCULATION TO THE SKIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone</td>
<td>Abnormal sounds: stridor, grunting, snoring, wheezing</td>
<td>Pallor</td>
</tr>
<tr>
<td>Irritable, interactive</td>
<td>Abnormal positioning: sniffing, tripoding, refusal to lie down</td>
<td>Mottling</td>
</tr>
<tr>
<td>Consolable</td>
<td>Retractions</td>
<td>Cyanosis</td>
</tr>
<tr>
<td>Look/gaze</td>
<td>Head bobbing</td>
<td>Petechiae</td>
</tr>
<tr>
<td>Speech/cry</td>
<td>Nasal flaring</td>
<td></td>
</tr>
</tbody>
</table>


### Table 166-4 Interpretation of the Pediatric Assessment Triangle

<table>
<thead>
<tr>
<th>PHYSIOLOGIC STATE</th>
<th>APPEARANCE</th>
<th>WORK OF BREATHING</th>
<th>CIRCULATION TO THE SKIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory distress</td>
<td>Normal</td>
<td>Abnormal</td>
<td>Normal</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>Abnormal</td>
<td>Abnormal</td>
<td>Normal-abnormal</td>
</tr>
<tr>
<td>Compensated shock</td>
<td>Normal</td>
<td>Normal</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Decompensated shock</td>
<td>Abnormal</td>
<td>Normal-abnormal</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Brain injury or dysfunction</td>
<td>Abnormal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Cardiopulmonary failure</td>
<td>Abnormal</td>
<td>Abnormal</td>
<td>Abnormal</td>
</tr>
</tbody>
</table>


**Work of Breathing.** The work of breathing should be observed initially from a distance because it is difficult to adequately assess work of breathing in a crying child. The position of the child can be a clue to the level of respiratory distress. Infants and children with respiratory distress may assume the sniffing position in an attempt to decrease their work of breathing. Tripoding is an ominous sign of severe respiratory distress.

The quality of the voice or cry may be a clue to airway and respiratory disease or compromise. For instance, children with croup have hoarse voices, and children with peritonsillar abscesses have muffled or “hot potato” voices. Abnormal breath sounds may be audible without a stethoscope. Stridor, audible wheezing, grunting, and snoring respirations can all be clues to respiratory compromise.

For adequate assessment for the presence of retractions and abdominal breathing, the infant or young child will ideally be observed without a shirt. Retractions may be seen in the suprasternal, supraclavicular, intercostal, and subcostal areas and are indicative of increased work of breathing (Fig. 166-3). Nasal

**Figure 166-2.** Pediatric assessment triangle.

**Figure 166-3.** Intercostal retractions in a child with respiratory distress.
flaring is an attempt to decrease airway resistance and is a sign of severe respiratory distress (Fig. 166-4). Head bobbing occurs when infants use neck muscles to assist respiration and is another sign of severe respiratory distress. Seesaw breathing, an ineffective breathing pattern in which the abdomen moves outward and the chest moves inward during inspiration, is a sign of impending respiratory failure. As the child tires and nears complete respiratory failure, the respiratory rate can fall and the work of breathing may be diminished.

Abnormal respiratory patterns may also be a clue to nonrespiratory illness. Effortless tachypnea may be a sign of shock. A rapid respiratory rate may be a physiologic attempt to correct for metabolic acidosis with respiratory alkalosis. Neurologic disorders may also lead to abnormal respiratory patterns.

Circulation. Visual inspection of the skin can provide clues to the overall cardiovascular status. Early compensated shock is characterized by peripheral vasoconstriction and shunting of blood to the brain and other vital organs. At this stage, pallor may be appreciated. If the shock state is not corrected, the patient may become mottled (Fig. 166-5A). Mottling is a random pattern of vasoconstriction and vasodilation in adjacent areas of the skin. This may be confused with cutis marmorata, a lacy pattern on the skin caused by vascular instability (Fig. 166-5B). Cutis marmorata is a normal finding in young infants in cool environments. In contrast to infants with mottling, infants with cutis marmorata will be otherwise well appearing, and the skin findings will diminish or disappear if the infant is bundled or placed in a warm environment. Cyanosis may be present normally in children with congenital heart disease, but if cyanosis is a new finding for the patient, it is indicative of respiratory failure or decompensated shock.

Physical Examination

The Glasgow Coma Scale is a useful way to objectively document the mental status examination and serves as an easy way to communicate the mental status to other providers. The pediatric modification for the Glasgow Coma Scale is shown in Table 166-5. A less comprehensive way to communicate the mental status is AVPU, or Alert, responsive to Verbal commands, responsive to Painful stimuli, or Unresponsive.

As in adults, the physical examination in critically ill or injured children will focus initially on airway, breathing, and circulation with correction of abnormalities in these systems before a complete physical examination is performed. In less critically ill infants and young children, auscultation of the heart and lungs should be performed before proceeding to frightening or uncomfortable parts of the examination. In general, the ears and oropharynx should be examined last because many children will cry, making the remainder of the physical examination difficult. Parents can hold frightened young children for ear examinations by holding the child in the lap with one arm around the head and one arm around the child's body and arms (Fig. 166-6). This allows the child to be held by the parent during an unpleasant part of the examination while having the head and arms adequately restrained to allow visualization of the tympanic membranes and avoidance of injury. When necessary, external examination of the vagina in young girls can be facilitated by having them sit in a frog-leg position in the parent's lap.
Fortunately, most pediatric visits to the emergency department are for minor illnesses and injuries, but emergency medicine providers need to be prepared to care for critically ill and injured children as well. The most common reasons for infants and children to be seen in emergency departments are respiratory illness, fever, and injury. Table 166-6 lists the most common emergency department diagnoses for infants and children in California, and Table 166-7 lists the most common reasons for hospitalization of pediatric patients in the United States. Causes of serious illness and injury vary by age. Respiratory illnesses are the most common causes of infant hospitalization after the immediate neonatal period. Asthma and appendicitis are the most common reasons for hospitalization of school-age children, and affective disorders are the most common cause of adolescent hospitalizations.

This section focuses on complaints specific to the pediatric population and complaints in which the differential and approach vary significantly from those in adult populations.

### Children with Special Health Care Needs

The assessment of children with chronic illnesses and other special health care needs is especially challenging. Parents or other daily caregivers can provide helpful information on baseline behavior and mental status, and the caregiver’s input should be sought.
However, relying on the parent’s knowledge and recollection of detailed medical information can be a problem, especially during times of high stress. Parents may forget medication names or concentrations. One solution is the use of an Emergency Information Form (EIF) for children with special health care needs. The form summarizes chronic medical conditions, medications, medical devices, and other critical information and is available at www.aap.org/advocacy/blankform.pdf. When they are accessible, these forms can quickly provide critical information to the emergency department provider, assisting in the early management and stabilization of the child until more detailed records are accessed or the specialist is contacted. Emergency departments can request that specialists affiliated with their hospitals provide EIFs for complex patients to facilitate rapid and appropriate emergency treatment.

Neonatal Intensive Care Unit Graduate

Ex-premature infants have unique health care needs and may be especially challenging to evaluate. Development is often delayed. It may be appropriate to consider gestational rather than chronologic age in assessing development. The parent’s report of change in tone, activity, and level of alertness should be taken seriously. Neonatal intensive care unit graduates are at increased risk for complications from respiratory infections and may have impaired immunity compared with term infants of the same chronologic age. Infants born significantly prematurely are at risk for chronic lung disease and may be receiving supplemental home oxygen, inhaled corticosteroids, bronchodilators, and diuretics. There may be some degree of tachypnea or increased work of breathing at baseline. Again, parental report of baseline respiratory status is helpful in decision-making.

Many high-risk infants receive respiratory syncytial virus (RSV) immunoglobulin monthly during peak season. During RSV season, the parents of ex-premature infants with fever, cough, rhinorrhea, or respiratory distress should be queried about timing of the last RSV immunoglobulin injection.

Altered Mental Status

Although many of the possible causes of altered mental status are the same in adults and children, a few considerations in the differential are unique to pediatrics. A mnemonic for causes of altered mental status in children is AEIOUTIPS (Box 166-2). The postictal state, central nervous system infection, and ingestions cause altered mental status in both adults and children. However, child abuse, intussusception, and inborn errors of metabolism are pediatric-specific causes of altered mental status that should also be considered.

Seizures

Although the initial basic management of seizures does not differ between children and adults, infantile seizures can be subtle. Seizure activity may be manifested by lip smacking, bicycling of the legs, or apnea. The possibility of a seizure should be considered for any infant with stereotyped repetitive movements. In addition, causes such as hyponatremia secondary to inappropriate formula dilution, inborn errors of metabolism, and pyridoxine deficiency are considerations in young infants presenting with seizures.

Febrile seizures are another diagnosis unique to pediatrics. Simple febrile seizures are brief generalized seizures occurring no more often than once in a 24-hour period in children between the ages of 6 months and 5 years. Simple febrile seizures require no specific treatment and in an otherwise well-appearing, vaccinated child do not by themselves necessitate further workup.

Trauma

Pediatric patients with blunt trauma have injury patterns different from those of adults. Children have relatively large heads in relation to their bodies, predisposing them to head trauma. They also have relatively elastic cervical spines and can have spinal cord injuries without radiologic evidence of injury. Therefore, any history of paresthesias, weakness, or other neurologic symptoms necessitates further investigation even if symptoms have resolved by the time of emergency department evaluation. Traumatic aortic injuries are less common in children than in adults. In children with tension pneumothorax, the mediastinum is more mobile, resulting rapidly in an obstructive form of shock. Children have less intraperitoneal fat than adults do, and their solid abdominal organs are relatively large compared with the abdominal cavity, predisposing to splenic and liver lacerations. The kidneys lack perirenal fat and are relatively mobile, predisposing to renal trauma. The bladder is an abdominal organ and is less protected by the pelvis in young children.

Child Abuse

Nonaccidental trauma should be a consideration for all patients presenting with injuries or with certain otherwise unexplained medical complaints, such as altered mental status and apparent life-threatening events. Many children with abusive injuries are not diagnosed as being the victims of abuse at initial health care encounters, leaving them at risk for more serious injuries and death. Historical clues to nonaccidental trauma include a mechanism inconsistent with the injury and a history inconsistent with the developmental level of the child (Box 166-3). Physical examination clues to abuse include bruises in young infants and bruises on certain areas of the body, such as the ear and trunk (Box 166-4). Fractures in children younger than 18 months without a significant witnessed trauma mechanism are especially concerning.

THE PEDIATRIC-READY EMERGENCY DEPARTMENT

Preparation to care for infants and children of all ages requires not only emergency department staff training but also pediatric medication formulations, intravenous fluids, and equipment and supplies in sizes appropriate for the premature neonate to the large adolescent. The American College of Emergency Physicians, the American Academy of Pediatrics, and the Emergency Nurses Association developed joint guidelines for care of children in the emergency department. The guidelines include recommendations on necessary personnel, protocols, medications, equipment, and

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**Box 166-2**

**Differential Diagnosis for Altered Mental Status in Children**

- A: Alcohol (adolescents), ammonia (inborn errors), abuse
- E: Electrolytes, encephalopathy
- I: Infection
- O: Oxygen, overdose
- U: Uremia
- T: Trauma, tumor
- I: Insulin (hypoglycemia), intussusception, inborn errors of metabolism
- P: Psychiatric, poisoning
- S: Seizure, shock, shunt malfunction, subarachnoid hemorrhage

supplies. Surveys have found that emergency departments frequently lack items recommended in the guidelines.\textsuperscript{3,28} One strong recommendation in the guidelines is the appointment of physician and nurse coordinators of pediatric emergency care.\textsuperscript{26,27}

Pediatric emergency preparedness requires a plan for continuing care of critically ill and injured children. Small community hospitals often do not have pediatric intensive care units or access to pediatric subspecialists. Therefore, a plan for transfer of patients whose needs exceed available resources is critical. Potential receiving hospitals and a mechanism of transporting critically ill pediatric patients should be identified.

**The Pediatric-Friendly Emergency Department**

One topic that has received increasing attention in recent years is pain and anxiety management in pediatric patients. Procedural pain is frequently undertreated in infants.\textsuperscript{29,30} Appropriate use of sedation, anesthesia, analgesia, and nonpharmacologic methods of pain management can increase the patient’s cooperation and increase visit satisfaction for the child and parent. Children have significant anxiety and fear surrounding medical procedures, leading to additional challenges in successful performance of procedures. In addition to reducing pain and anxiety in the acute visit, adequate pain control is likely to have long-term benefits. Multiple studies have demonstrated that inadequate pain control can have long-term deleterious consequences, leading to increased pain perception with future painful procedures.\textsuperscript{31}

A variety of options are available to minimize pain associated with drawing of blood and starting of intravenous lines, including vapocoolants, topical anesthetics, and needle-free jet injection of anesthetics.\textsuperscript{32} Topical anesthetics can also decrease the pain of anesthetic injection before lumbar puncture and other procedures. Topical application of a lidocaine, epinephrine, and tetracaine mixture has been shown to have comparable efficacy to injected anesthesia for facial and scalp lacerations.\textsuperscript{33} Oral sucrose seems to decrease procedural pain in neonates.\textsuperscript{34} Nonpharmacologic distraction techniques such as bubbles, songs, books, videos, and videogames can be used to decrease anxiety.\textsuperscript{35} In children, the use of anxiolytic medications or procedural sedation may be appropriate for procedures that could be accomplished with local anesthesia in more mature patients.

Another shift in recent years is increased support for family presence during invasive procedures and resuscitations.\textsuperscript{35-37} Children are stressed when they are separated from parents, and one benefit of family presence is that parents are able to reassure and calm the child.\textsuperscript{38} Studies have shown that family presence also decreases anxiety levels in family members.\textsuperscript{39} Presence during unsuccessful cardiopulmonary resuscitation is perceived by families as beneficial in the grieving process.\textsuperscript{40} Studies have shown that with well-implemented policies, family presence does not interfere with resuscitation.\textsuperscript{41}

Families present during resuscitations should have a family support person assigned who can explain procedures and answer questions. A social worker, chaplain, or nurse could fulfill this role. Ideally, families are briefed on what to expect before entering the resuscitation room. Guidelines have been developed to assist emergency department providers in implementing family presence protocols at their institutions.\textsuperscript{38
References


