Pediatric Assessment and Management

Objectives

Cognitive

6-1.4 Indicate various causes of respiratory emergencies. (p 965)
6-1.5 Differentiate between respiratory distress and respiratory failure. (p 975)
6-1.6 List the steps in the management of foreign body airway obstruction. (p 959)
6-1.7 Summarize emergency medical care strategies for respiratory distress and respiratory failure. (p 976)
6-1.8 Identify the signs and symptoms of shock (hypoperfusion) in the infant and child patient. (p 977)
6-1.9 Describe the methods of determining end organ perfusion in the infant and child patient. (p 946)
6-1.10 State the usual cause of cardiac arrest in infants and children versus adults. (p 970)
6-1.12 Describe the management of seizures in the infant and child patient. (p 978)
6-1.14 Discuss the field management of the infant and child trauma patient. (p 971)

Affective

None

Psychomotor

6-1.21 Demonstrate the techniques of foreign body airway obstruction removal in the infant. (p 962)
6-1.22 Demonstrate the techniques of foreign body airway obstruction removal in the child. (p 959)
6-1.23 Demonstrate the assessment of the infant and child. (p 943)
6-1.24 Demonstrate bag-valve-mask artificial ventilations for the infant. (p 956)
6-1.25 Demonstrate bag-valve-mask artificial ventilations for the child. (p 956)
6-1.26 Demonstrate oxygen delivery for the infant and child. (p 954)

Additional Objectives*

Cognitive

1. Describe the steps in positioning an infant and/or child to maintain an open airway. (p 950)
2. Summarize neonatal resuscitation procedures. (p 963)

Affective

None

Psychomotor

3. Demonstrate the techniques necessary in neonatal resuscitation. (p 963)

*These are noncurriculum objectives.

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Pediatric Assessment and Management

You are the Provider

You and your EMT-B partner are sitting in Casa Molinas having lunch when you hear someone coughing behind you. You turn around to see a young girl standing next to her chair with her hand over her mouth, coughing and turning red in the face. Her mother is yelling, "Jamie, are you ok? Are you ok?" as she pats her briskly on the back.

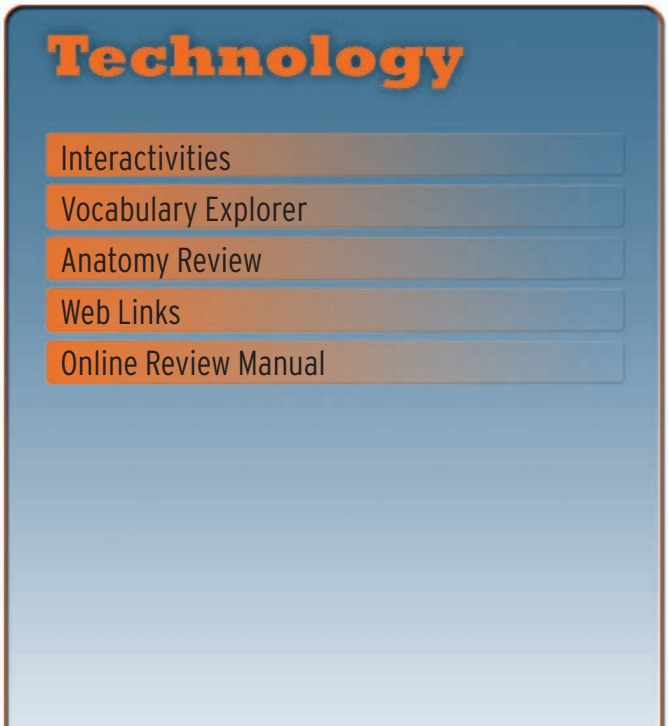
1. What should you do?
2. Can you provide treatment to this child?

Pediatric Assessment and Management

There are many causes of emergencies in infants and children. Although you might not be able to identify the exact cause, you must be able to intervene appropriately. You will face some special challenges in caring for sick and injured children. First and foremost is the ability to assess the needs of infants and children. Other challenges will include managing the child's airway, ventilations, and the care of injuries.

This chapter examines the importance of assessment and setting priorities when dealing with children. Discussion of procedures for opening and maintaining the airway in infants and children follows, including placement of airway adjuncts and use of oxygen delivery devices, including the bag-valve-mask (BVM) device. The causes and management of airway obstruction from foreign objects are covered next. After the management of children with trauma, seizures, altered level of consciousness, poisoning, meningitis, shock, and dehydration are outlined, a brief review of neonatal resuscitation is provided.

EMT-Bs who are calm when caring for adults often find themselves anxious when dealing with critically ill or injured infants or children. However, treatment of children is the same as that of adults in most emergency situations. Once you understand the differences in anatomy between children and adults and learn to recognize signs of respiratory distress in children, you will find it easier to approach even the youngest patients in a relaxed, professional manner.



Because a young child might not be able to speak, your assessment of his or her condition must be based in large part on what you can see and hear yourself. In addition, families may be helpful in providing vital information about an accident or illness. You should include families as part of the caregiving team and, whenever possible, include them in all decisions about care and transportation.

Scene Size-up

As with any EMS call, the scene size-up begins by ensuring that you and your partner have taken the appropriate BSI precautions. As soon as you arrive at the scene, look for any hazards or potential threats to you or your partner. Resist the temptation to hastily access the patient because you know it is a child. Personal safety must always remain your priority.

As you enter the scene, note the position in which the child is found. Observe the area for clues to the mechanism of injury (MOI) or nature of illness (NOI); these observations will help guide your assessment and management priorities.

Note the presence of any pills, medicine bottles, or household chemicals that would suggest possible ingestion by the child. If the child has been injured—a motor vehicle crash, fall, or pedestrian incident—carefully observe the scene or vehicle (if involved) for clues to the potential severity of the child's injuries.

You must not discount the possibility of child abuse. Conflicting information from the parents or caregivers, bruises or other injuries that are not consistent with the MOI described, or injuries that are not consistent with the child's age and developmental abilities should increase your index of suspicion for abuse.

Initial Assessment

Many components of the pediatric initial assessment can be accomplished by simple observation when you first enter the scene or room. As with the adult, the objective of the initial assessment is to identify and treat immediate or potential threats to life.

General Impression

The initial assessment begins as you form a general impression of the child's condition and of the environment in which he or she is found. Determining a chief

complaint, often expressed as what the parent is most concerned about, may help to focus your attention toward potential life-threatening problems. Also note the degree of interaction between the parent or caregiver and the child; ask the parent or caregiver if the child is acting normally. Determine whether the child recognizes the parent or caregiver; failure to do so is an ominous sign and indicates a very sick child.

Pediatric Assessment Triangle

The pediatric assessment triangle (PAT) is a structured assessment tool that allows you to rapidly form a general impression of the infant's or child's condition without touching him or her. The intent is to provide a "first glance" assessment to identify the general category of the child's physiologic problem and to establish urgency for treatment and/or transport. The PAT is a visual assessment of the child before performing a hands-on assessment.

The PAT (Figure 32-1 ▼) consists of three elements: appearance (muscle tone and mental status), work of breathing, and circulation to the skin. The only equipment required for the PAT are your own eyes and ears; no stethoscope, blood pressure cuff, cardiac monitor, or pulse oximeter is required.

Appearance

Evaluating the child's appearance involves noting the level of consciousness or interactiveness and muscle tone—signs that will provide you with information about the adequacy of the child's cerebral perfusion and overall function of the central nervous system.

Much of the information regarding the child's level of consciousness can be obtained by using the PAT. In addition, you can evaluate the child's level of consciousness by using the AVPU scale, modified as necessary for the child's age (Table 32-1 ▶).

TABLE 32-1 The AVPU Scale

Alert: Normal interactiveness for age

Verbal
- Appropriate: Responds to name
- Inappropriate: Nonspecific or confused

Painful
- Appropriate: Withdraws from pain
- Inappropriate: Sound or movement without purpose or localization of pain

Unresponsive: No response to any stimulus

An infant or child with a normal level of consciousness will act appropriately for his or her age, exhibiting good muscle tone and maintaining good eye contact (Figure 32-2 ▼). An abnormal level of consciousness is characterized by age-inappropriate behavior or interactiveness, poor muscle tone, or poor eye contact with the caregiver or EMT-B (Figure 32-3 ▼).

Figure 32-2 An infant or child making good eye contact is not very sick.

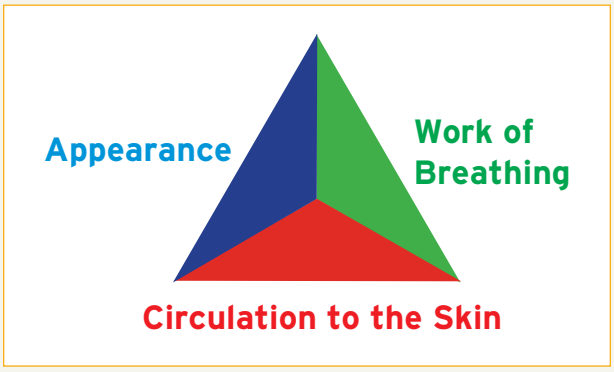


Figure 32-1 The three components of the pediatric assessment triangle (PAT) include appearance, work of breathing, and circulation to the skin.

Figure 32-3 A limp child who is unable to maintain eye contact may be critically ill or injured.

Figure 32-4 Retractions of the intercostal muscles or sternum indicate increased work of breathing.

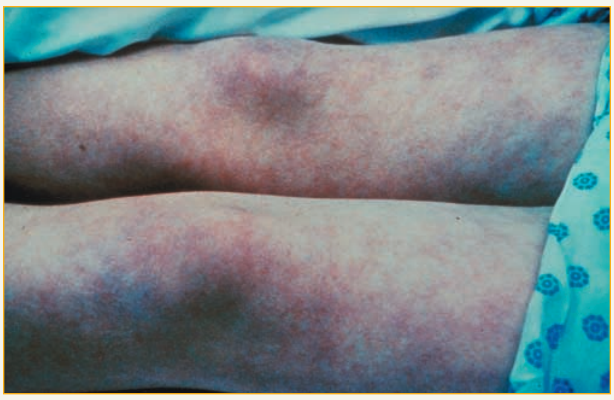


Figure 32-5 Mottling of the skin indicates poor perfusion and is the result of constriction of peripheral blood vessels.

Work of Breathing

A child's work of breathing increases as the body attempts to compensate for abnormalities in oxygenation and ventilation. Increased work of breathing often manifests as tachypnea, retractions of the intercostal muscles or sternum Figure 32-4 ▲, or the way the child positions himself or herself.

Circulation to the Skin

An important sign of perfusion is circulation to the skin. When cardiac output falls, the body, through vasoconstriction, shunts blood from areas of lesser need (such as the skin) to areas of greater need (such as the brain, heart, and kidneys).

Pallor of the skin and mucous membranes may be seen in compensated shock; it may also be a sign of anemia or hypoxia. Mottling is caused by constriction of peripheral blood vessels and is another sign of poor perfusion Figure 32-5 ▶.

Cyanosis, a blue discoloration of the skin and mucous membranes, reflects a decreased level of oxygen in the blood. Cyanosis is a late sign of respiratory failure or shock; absence of discoloration, however, does not rule out these conditions. Never wait for the development of cyanosis before administering oxygen!

Airway, Breathing, and Circulation

After forming your general impression of the child's condition using the PAT, perform a hands-on assessment of the child's vital functions—airway, breathing, and circulation—and treat any immediate or potential threats to life. As previously discussed, although your assessment of the child may require some modification based on patient age, the overall assessment flow is essentially the same as for adults.

Airway Assessment

If the infant or child's airway is open and the patient can adequately keep it open (as is often the case in conscious patients), you can proceed with assessment of respiratory adequacy. However, if the child is unresponsive or has difficulty keeping the airway clear, you must ensure that the airway is properly positioned and that it is clear of mucus, vomitus, blood, and foreign bodies.

If trauma has been ruled out, open the child's airway with the head tilt–chin lift maneuver Figure 32-6 ▶. If the child has been involved in trauma or trauma is suspected, use the jaw-thrust maneuver to open the airway Figure 32-7 ▶.

Positioning the airway correctly is critical in pediatric emergency care. Position the airway in a sniffing position, which may require the placement of a folded sheet or towel behind the head or shoulders Figure 32-8 ▶. When the head is bent back (hyperextended) or forward (flexed), the airway may become obstructed because of kinking of the trachea.

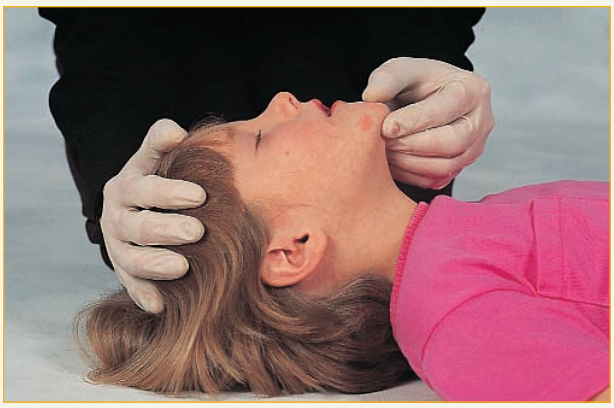


Figure 32-6 Use the head tilt–chin lift maneuver to open the airway of a child without trauma.

Figure 32-7 Use the jaw-thrust maneuver in a child with possible spinal injury.

After the child's airway has been opened, make sure that it is clear of potential obstructions such as mucus, blood, or foreign bodies. Next, establish whether the child can maintain his or her own airway spontaneously (without the use of airway adjuncts) or whether adjuncts will be necessary to maintain airway patency. Techniques of airway management will be discussed later in this chapter.

Breathing Assessment

Assess the child's breathing by using the look, listen, and feel technique, noting the degree of air movement at the nose and mouth and determining whether the chest is rising adequately. In infants, belly breathing is considered adequate due to the soft pliable bones of the chest and the strong muscular diaphragm.

If the child is conscious and not in need of immediate intervention (such as suctioning or assisted ventilation), assessing respirations is usually easier with the child sitting on the caregiver's lap. Listen for abnormal respiratory sounds (Table 32-2 ▶), and note any signs of increased respiratory effort.

When observing the child's respiratory effort, note any signs of increased work of breathing, including:

- **Accessory muscle use:** Contractions of the muscles above the clavicles (supraclavicular)
- **Retractions:** Drawing in of the muscles between the ribs (intercostal retractions) or of the sternum during inspiration
- Head bobbing: The head lifts and tilts back during inspiration, then moves forward during expiration

Figure 32-8 The airway should be placed in a neutral position to keep the trachea from kinking when the head is flexed or hyperextended.

TABLE 32-2 Abnormal Respiratory Sounds

- **Stridor:** High-pitched inspiratory sound; indicates a partial upper airway obstruction (such as in croup or from a foreign body)
- **Wheezing:** High- or low-pitched sound heard usually during expiration; indicates a partial lower airway obstruction (such as in asthma or bronchiolitis)
- Grunting: An "uh" sound heard during exhalation; reflects the child's attempt to keep the alveoli open; indicates inadequate oxygenation
- **Absent breath sounds (despite increased work of breathing):** Indicates a complete upper or lower airway obstruction (such as foreign body, severe asthma, or pneumothorax)

- Nasal flaring: The nares (the external openings of the nose) widen; usually seen during inspiration
- **Tachypnea:** Increased respiratory rate

As the child begins to tire, retractions often become weak and ineffective and the accessory muscles become less prominent during breathing. Bradypnea, a decrease in the respiratory rate, is an ominous sign and indicates impending respiratory arrest. Do not mistake bradypnea for a sign of improvement; it usually indicates that the child's condition has deteriorated. Therefore, you must be prepared to begin ventilatory assistance.

Circulatory Assessment

When assessing circulation, you must determine if the child has a pulse, is bleeding, or is in shock. Remember, infants and children can tolerate only small amounts of blood loss before circulatory compromise occurs. Assess and control any active bleeding early in your assessment.

Pulses may be difficult to palpate if they are weak, very fast, or very slow. In infants, palpate the brachial pulse or femoral pulse. In children older than 1 year, palpate the carotid pulse Figure 32-9 ▶. Note the rate and quality of the pulse: Is it weak or strong? Is it normal, slow, or fast? Strong central pulses usually indicate that the child is not hypotensive; however, this does not rule out the possibility of compensated shock. Weak or absent peripheral pulses indicate decreased perfusion. The absence of a central pulse (that is, brachial or femoral in infants, carotid in older children) indicates the need for CPR.

Tachycardia may be an early sign of hypoxia or shock, but it may also reflect less serious conditions such as fever, anxiety, pain, and excitement. Like respiratory rate and effort, heart rate should be interpreted within the context of the overall history, PAT, and entire initial assessment.

A trend of increasing or decreasing heart rate may be quite useful and may suggest worsening hypoxia or shock or improvement after treatment. When hypoxia or shock becomes critical, bradycardia occurs. As with slowing respirations, bradycardia in a child is an ominous sign and often indicates impending cardiopulmonary arrest.

Feel the skin for temperature and moisture at the same time you assess the child's pulse. Is the skin warm and dry, or cold and clammy? Estimate the capillary refill time (CRT) by squeezing the end of a finger or toe for several seconds and then observing the return of blood to the area Figure 32-10 ▶. Color should return in less than 2 seconds after you let go. The CRT is used to assess end-organ perfusion. It is most reliable in children younger than 6 years; however, factors such as cold temperatures may affect the CRT.

Transport Decision

After you have completed the initial assessment and initiated any treatment, you must make a crucial decision: Is immediate transport to the hospital indicated, or is additional assessment and treatment required at the scene? If the child is in stable condition, you may elect to perform a focused history and physical exam at the scene.

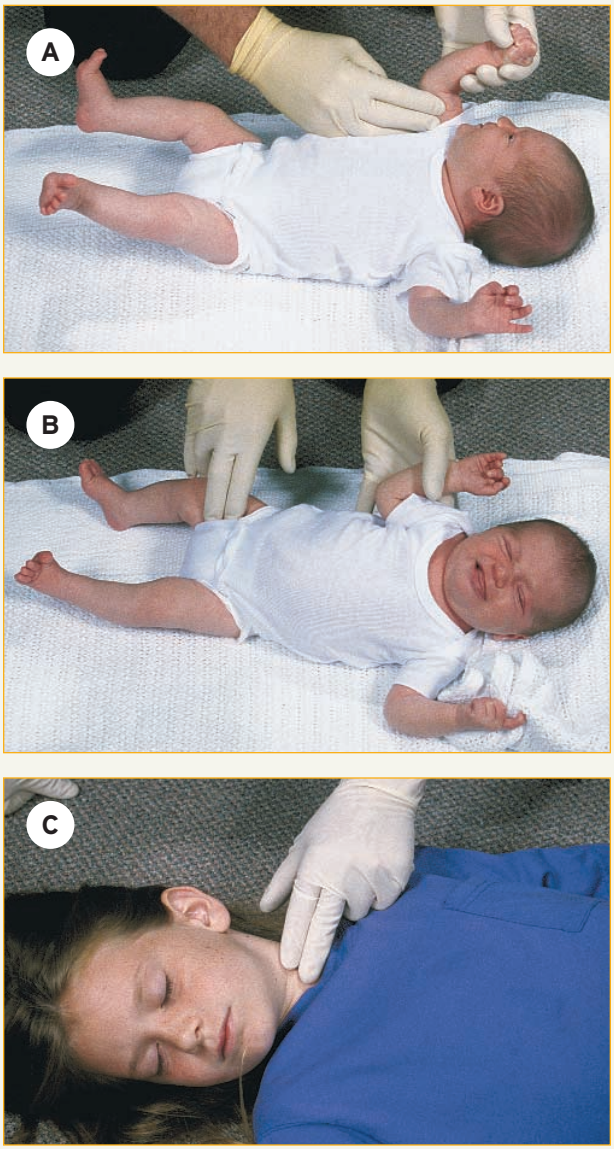


Figure 32-9 **A.** Palpate the brachial pulse in infants. **B.** Palpate the femoral pulse as a second choice. **C.** In children older than 1 year, palpate the carotid pulse.

Figure 32-10 Estimate the capillary refill time by squeezing the end of a finger or toe for several seconds until the nailbed blanches. Normal color should return within 2 seconds after you let go.

However, immediate transport is indicated if the scene is unsafe for the child or if any of the following conditions exist:

- A significant MOI—same MOIs as adults (see Chapter 21), with the addition of:
  - Any fall from a height equal to or greater than a child's height, especially with a headfirst landing
  - Bicycle crash
- A history compatible with a serious illness
- A physiologic abnormality noted during the initial assessment
- A potentially serious anatomic abnormality
- Significant pain
- Level of consciousness is not normal for the child, altered mental status, and/or any signs or symptoms of shock

In addition to the preceding factors, the EMT-B should also consider the following when making a transport decision:

- The type of clinical problem (injury versus illness)
- The expected benefits of ALS treatment in the field
- Local EMS system treatment and transport protocols
- The EMT-B's comfort level
- Transport time to the hospital

If the child's condition is urgent, perform a rapid assessment, if applicable, and initiate immediate transport. Additional assessment and treatment should occur en route to the hospital.

If the child's condition is nonurgent, perform a focused history and physical exam at the scene, provide additional treatment as needed, and then transport.

Transportation

Children weighing less than 40 lb should be transported in a car seat as long as the situation allows. Many types of seats are available. A seat should be chosen to fit the appropriate weight of the child and should meet the current applicable standards set by your governing agency. There are only a few locations to place a car seat in an ambulance. Seats are designed to be either forward-facing or rear-facing; they cannot be mounted sideways on a bench seat. Seats should not be mounted in the front of an ambulance, especially if the ambulance is equipped with airbags. To mount a car seat to the stretcher, place the head of the cot in an upright position. Place the seat so it is against the back of the cot. Secure one of the cot straps from the upper portion of the cot through the seat belt positions on the seat and strap it tightly to the cot. Repeat on the lower portion of the cot. Push the seat into the cot tightly and retighten the straps.

To secure a seat to the captain's chair, follow the seat manufacturer's instructions. Remember that children younger than 1 year must be transported in a rear-facing position due to the lack of mature neck muscles.

In some situations, it is not appropriate to secure a child in a car seat, for example if the child has to be immobilized on a long board or requires splinting that does not fit in the seat. If the child is unstable and requires airway or ventilatory support, he or she should be positioned to maximize the airway and ventilatory requirements. Children in cardiopulmonary arrest should likewise not be placed in a car seat.

Transition Phase

If the child's condition does not require immediate transport, the transition phase can allow the infant or child to become familiar with you and your equipment. This will help to alleviate the child's anxiety, allowing you to perform a more thorough and accurate assessment.

Remember that sick or injured children are afraid and do not understand why you are there and what you are doing. As a result, they are less likely than an adult to trust you. The transition phase will facilitate the trust-building process between you and the child.

Focused History and Physical Exam

A focused history and physical exam of a child should be performed at the scene, unless his or her condition dictates immediate transport. The purpose of the focused history and physical exam is to obtain additional, specific information about the child's illness or injury. This portion of your assessment includes performing a

physical exam (either rapid or focused), obtaining vital signs, and interviewing the patient or guardian about the patient's medical history. The order of these three portions of the assessment will vary according to whether the child is a medical patient (responsive or unresponsive) or a trauma patient (with significant MOI or non-significant MOI). Refer to Chapter 8 to review the appropriate order of assessment steps.

Focused Physical Exam

The focused physical exam should be performed on all children without life-threatening illnesses or injuries who do not require a rapid assessment (for example, responsive children where obtaining a medical history will guide you in your physical exam or trauma patients with a non-significant MOI). Focus your assessment on the area(s) of the body affected by the illness or injury.

Young children should be assessed starting at the feet and ending at the head; older children can be assessed using the head-to-toe approach, as with adults. The extent of the physical exam will depend on the situation and may include the following:

- Pupils
  - Note the size, equality, and reactivity of the pupils to light
- Capillary refill (in children younger than 6 years)
  - Normal CRT should be less than 2 seconds
  - As discussed earlier, assess CRT by blanching the finger or toenail beds; the soles of the feet may also be used
  - Cold temperatures will increase CRT, making it a less reliable sign
- Level of hydration
  - Assess skin turgor, noting the presence of tenting
  - In infants, note whether the fontanels are sunken or flat
  - Ask the parent or caregiver how many diapers the infant has soiled over the last 24 hours
  - Determine whether the child is producing tears when crying; note the condition of the mouth. Is the oral mucosa moist or dry?

Rapid Physical Exam

A rapid physical exam should be used when pediatric patients have potentially life-threatening or hidden injuries, for example, unresponsive medical patients or trauma patients with a significant MOI. This rapid head-to-toe (or toe-to-head) exam may help to identify external bleeding, a distended abdomen, or possible fractures. It should be performed quickly, and then vital signs and history should be obtained. Identifying these problems early can help to prepare your patient for transport or identify the need for ALS providers.

Pediatric Vital Signs

You should take a child's vital signs in the field because you are the eyes, ears, and hands of medical control. During your assessment, you should obtain a complete set of baseline vital signs, including pulse, skin color, temperature and condition, blood pressure, respirations, and pupils. Guidelines used to assess adult circulatory status—heart rate and blood pressure—have important limitations in children. First, normal heart rates vary with age in children. Second, blood pressure is usually not assessed in children younger than 3 years; it offers little information about the child's circulatory status and is usually difficult to obtain. In these patients, assessment of the skin is a better indication of their circulatory status.

It is important to use appropriately sized equipment when assessing a child's vital signs. To obtain an accurate reading of a child's blood pressure, you must use a cuff that covers two thirds of the patient's upper arm. A blood pressure cuff that is too small may give you a falsely high reading, whereas a cuff that is too large may give you a falsely low reading.

Respiratory rates may be difficult to interpret. Rapid respiratory rates may simply reflect high fever, anxiety, pain, or excitement. Normal rates, on the other hand, may occur in a child who has been breathing rapidly with increased work of breathing for some time and is now becoming tired. Count the respirations for at least 30 seconds and then double that number (if counted for 30 seconds). In infants and children younger than 3 years, evaluate respirations by assessing the rise and fall of the abdomen. Assess the pulse rate by counting for at least 1 minute, noting its quality and regularity. Pulse oximetry can also be used to monitor the patient's status Figure 32-11 ▶.

Note that normal vital signs in pediatric patients vary with the age of the child Table 32-3 ▶. Remember that your approach to taking vital signs also varies with the age of the child. Be gentle, talk to the child, assess respirations and then pulse, and assess blood pressure last. Warm your stethoscope on your hands or a cloth before placing it on the skin. You may also want to let the child hold the equipment or stethoscope first; this may help to reduce the child's anxiety.

Evaluate pupils in the child using a small pen light. The response of pupils is a good indication of how well the brain is functioning, particularly when trauma

TABLE 32-3 Vital Signs by Age

Age	Respirations (breaths/min)	Pulse (beats/min)	Systolic Blood Pressure (mm Hg)
Newborn: 0 to 1 month	30 to 60	90 to 180	50 to 70
Infant: 1 month to 1 year	25 to 50	100 to 160	70 to 95
Toddler: 1 to 3 years	20 to 30	90 to 150	80 to 100
Preschool age: 3 to 6 years	20 to 25	80 to 140	80 to 100
School age: 6 to 12 years	15 to 20	70 to 120	80 to 110
Adolescent: 12 to 18 years	12 to 16	60 to 100	90 to 110
Older than 18 years	12 to 20	60 to 100	90 to 140

Figure 32-11 Pulse oximetry, which measures the patient's oxygen saturation, can be used to monitor the patient's status.

has occurred. Be sure to compare the size of the pupils against each other.

SAMPLE History

Your approach to the history will depend on the age of the patient. Historical information for an infant, toddler, or preschool-age child will need to be obtained from the parent or caregiver. When dealing with a school-age child or young adolescent, you will usually be able to obtain most of the information from the patient.

Information about sexual activity, the possibility of pregnancy, or the use of illicit drugs or alcohol should be obtained from an older adolescent patient in private. Most of these patients will be reluctant to provide this information in the presence of their parents. When asking such questions, assure the adolescent that this information is important and is needed to provide the most appropriate care.

Questioning of the parent or child about the immediate illness or injury should be based on the child's chief complaint. Together with an evaluation of the child's medical history, this may provide clues to the underlying illness or injury and other conditions that may exist.

When interviewing the parent or older child about the chief complaint, obtain the following pertinent information:

- Nature of the illness or injury
- How long the patient has been sick or injured
- Presence of fever
- Effects of the illness or injury on the child's behavior
- Change in bowel or bladder habits
- Presence of vomiting or diarrhea
- Frequency of urination

When obtaining information about the child's medical history, use SAMPLE to inquire whether the child is currently under the care of a physician, has any chronic illnesses, takes any medications on a regular basis, or has any known drug allergies.

If the caregiver is unable to accompany you to the hospital, get a name and phone number so the staff can call if there are questions. This might be the case when you respond to a daycare facility or babysitter's location. Care may be delayed if this information is not discovered early.

Detailed Physical Exam

Oftentimes pediatric patients will require constant intervention and observation in transit to the hospital. In these situations, or when priority problems require your attention, a detailed exam may not be necessary.

Documentation Tips

Because of the frequency of serious internal injuries in children who show no external signs, it is especially important to investigate and thoroughly document the MOI. Don't let the rush at the scene distract you from determining the mechanism, or at least directing another reliable responder to do so. Hospital care providers need this information.

However, in many situations pediatric patients should have a thorough detailed physical exam, looking over their complete body for signs and symptoms of problems. This is particularly true of patients experiencing trauma from a significant MOI where subtle signs of injury may be present. Use DCAP-BTLS to help remind you what to look for.

Ongoing Assessment

Reassess the child's condition as the situation dictates—every 15 minutes for a child in stable condition and at least every 5 minutes for a child in unstable condition.

The physiologic safeguards in infants and children can decompensate with alarming unpredictability; therefore, continually monitor respiratory effort, skin color and condition, and level of consciousness or interactiveness. Frequently reassess vital signs and temperature. If the child's condition deteriorates, immediately repeat the initial assessment and adjust your treatment accordingly.

The Pediatric Airway

Positioning the Airway

Correct positioning of the airway is critical in pediatric emergency care. Always position the airway in a neutral sniffing position as shown earlier. This accomplishes two goals at once, keeping the trachea from kinking and maintaining the proper alignment should you have to immobilize the spine. If the child has been involved in trauma or trauma is suspected, use the jaw-thrust maneuver to open the airway.

Follow these steps to position the airway in a child or infant (Skill Drill 32-1 ▶):

1. **Place the patient on a firm surface** such as a short backboard or pediatric immobilization device (**Step 1**).
2. **Fold a small towel to a thickness of approximately 1″, and place it under the patient's shoulders and back** (**Step 2**).
3. **Place tape across the child's forehead** to limit rolling of the head during transport (**Step 3**).

Airway Adjuncts

In children with inadequate ventilation, whatever the reason, you should use an airway adjunct to maintain an open airway. Airway adjuncts are devices that help to maintain the airway or assist in providing artificial ventilation, including oral and nasal airways, bite blocks, and BVM devices. Placing the adjuncts correctly starts with choosing the appropriately sized equipment (Table 32-4 ▼).

TABLE 32-4 Pediatric Equipment: Getting the Size Right

The best way to identify the appropriately sized equipment for a pediatric patient is to use the pediatric resuscitation tape measure, which can determine weight as well as height in patients weighing up to 75 lb (34 kg) (Figure 32-12 ▶). The proper sequence for using the tape is the following:

1. Place the patient supine on a flat surface.
2. Lay the tape next to the patient with the multicolored side up.
3. Place the red end of the tape at the top of the patient's head.
4. Place one hand with its side down on top of the patient's head, covering the red box at the end of the tape.
5. Starting from the patient's head, run the side of your free hand down the tape.
6. Stretch the tape out the full length of the child, stopping at the heel. If the child is longer than the tape, stop here and use the appropriate adult technique.
7. Place your free hand, side down, at the bottom of the child's heel.
8. Note the color or letter block and weight range on the edge of the tape where your hand is. Say the color or letter out loud.
9. Select the appropriately sized equipment by matching the color or letter on the tape to the color or letter on the equipment.

Positioning the Airway in a Child

Skill Drill 32-1

1 Position the child on a firm surface.

2 Place a folded towel about 1″ thick under the shoulders and back.

3 Immobilize the forehead to limit movement and use the head tilt–chin lift to open the airway.

Oropharyngeal Airway

An oropharyngeal airway is designed to keep the tongue from blocking the airway, and it makes suctioning the airway, if necessary, easier. An oropharyngeal airway should be used for pediatric patients who are unconscious and in possible respiratory failure. This adjunct should not be used in either conscious patients or those who have a gag reflex. Patients with a gag reflex do not tolerate an oropharyngeal airway. In addition, this adjunct should not be used in children who may have ingested a caustic or petroleum-based product, as it may induce vomiting.

Skill Drill 32-2 ▶ shows the steps for inserting an oropharyngeal airway in a child:

1. **Determine the appropriately sized airway** by measuring from the corner of the patient's mouth to the earlobe, or by using the length-based pediatric resuscitation tape.
2. **Place the airway next to the face** with the flange at the level of the central incisors and the bite block segment parallel to the hard palate. The tip of the airway should reach the angle of the jaw (**Step 1**).

Figure 32-12 Use of a pediatric resuscitation tape measure is one way to identify the correct size for airway adjuncts.

3. **Position the patient's airway.** If the emergency is medical, use the head tilt-chin lift technique, avoiding hyperextension; you may place a towel under the patient's shoulders. If the patient has a traumatic injury, use the jaw-thrust maneuver and provide in-line spinal stabilization (**Step 2**).
4. **Open the mouth** by applying pressure on the chin with your thumb.
5. **Insert the airway** by depressing the tongue with a tongue blade applied to the base of the tongue and inserting the airway directly over the tongue blade. If a tongue blade is not available, point the airway tip toward the roof of the mouth to depress the tongue. Gently rotate the airway into position as it passes through the mouth toward the curve of the tongue. Insert the airway until the flange rests against the lips.
6. **Reassess the airway after insertion** (**Step 3**). Take care to avoid injuring the hard palate as you insert the airway. Rough insertion can cause bleeding, which can aggravate airway problems and may even cause vomiting. Note also that if the patient's airway is too small, the tongue may be pushed back into the pharynx, obstructing the airway. If the airway is too large, it may obstruct the larynx.

Nasopharyngeal Airway

A nasopharyngeal airway is also an airway adjunct. It is usually well tolerated and is not as likely as the oropharyngeal airway to cause vomiting. Unlike the oropharyngeal airway, the nasopharyngeal airway is used for conscious patients or for patients with altered levels of consciousness. In pediatric patients, the nasopharyngeal airway is typically used in association with possible respiratory failure. It is rarely used in infants younger than 1 year.

A nasopharyngeal airway should not be used in patients with nasal obstruction or head trauma (possible basal skull fracture), or in patients with moderate to severe head trauma, as this adjunct could increase intracranial pressure.

Follow the steps in Skill Drill 32-3 ▶ to insert a nasopharyngeal airway in a child:

1. **Determine the appropriately sized airway.** The external diameter of the airway should not be larger than the diameter of the nares, and there should be no blanching of the naris after insertion.
2. **Place the airway next to the patient's face** to make sure the length is correct. The airway should extend from the tip of the nose to the tragus of the ear. The tragus is the small cartilaginous projection in front of the opening of the ear.
3. **Position the patient's airway**, using the techniques described above for the oropharyngeal airway (**Step 1**).
4. **Lubricate the airway** with a water-soluble lubricant.
5. **Insert the tip into the right naris** (nostril opening) with the bevel pointing toward the septum, or central divider in the nose (**Step 2**).
6. **Carefully move the tip forward, following the roof of the mouth,** until the flange rests against the outside of the nostril (**Step 3**). If you are inserting the airway on the left side, insert the tip into the left naris upside down, with the bevel pointing toward the septum. Move the airway forward slowly about 1″ until you feel a slight resistance, and then rotate the airway 180°.
7. **Reassess the airway** after insertion.

As with the oropharyngeal airway, there can be problems with the nasopharyngeal airway. An airway with a small diameter may easily become obstructed by mucus, blood, vomitus, or the soft tissues of the pharynx. If the airway is too long, it may stimulate the vagus nerve and slow the heart rate or enter the esophagus, causing gastric distention. Inserting the airway in responsive patients may cause a spasm of the larynx and result in vomiting. Nasopharyngeal airways should not be used when patients have facial trauma, as the airway may tear soft tissues and cause bleeding into the airway.

Inserting an Oropharyngeal Airway in a Child

Skill Drill 32-2

1 Determine the appropriately sized airway. Confirm the correct size visually, by placing it next to the patient's face.

2 Position the patient's airway with the appropriate method.

3 Open the mouth. Insert the airway until the flange rests against the lips. Reassess the airway.

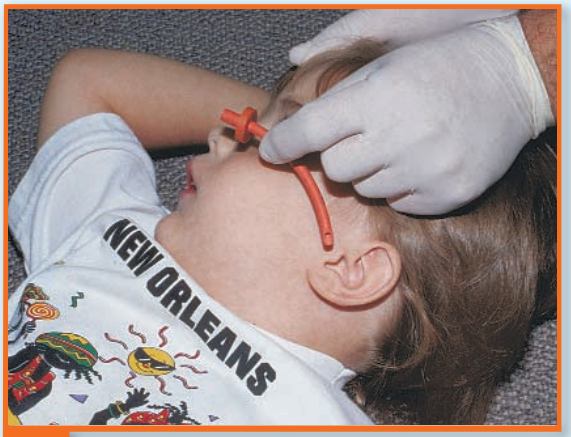
You are the Provider — Part 2

Seeing the distressed look in the child's eyes, you quickly get up, introduce yourself, and ask if you can be of assistance. Her mother smacks her on the back again and says, "Please help her! I think she's choking!" Jamie suddenly grasps her throat.

3. What do the child's actions indicate?
4. Are the mother's back blows to the child significant in this situation?

Skill Drill 32-3

Inserting a Nasopharyngeal Airway in a Child



1 Determine the correct airway size by comparing its diameter to the opening of the nostril (naris). Place the airway next to the patient's face to confirm correct length.

Position the airway.

2 Lubricate the airway. Insert the tip into the right naris with the bevel pointing toward the septum.

3 Carefully move the tip forward until the flange rests against the outside of the nostril.

Reassess the airway.

Assisting Ventilation and Oxygenation

After opening the airway, you should assess the patient's ventilation status. Look, listen, and feel for breathing. Remember to observe chest rise in older children and abdominal rise in younger children and infants. Skin condition indicates the amount of oxygen getting to the organs of the body. Patients who have pale, mottled, or blue skin may have inadequate levels of oxygen in their blood. All trauma patients should receive oxygen. If the patient has sustained trauma to the face, assisting ventilations may be difficult.

Oxygen Delivery Devices

In treating infants and children who require more than the usual 21% oxygen found in room air, you have several options:

- Nonrebreathing mask at 10 to 15 L/min provides up to 90% oxygen concentration.
- Blow-by technique at 6 L/min provides more than 21% oxygen concentration.
- Nasal cannula at 1 to 6 L/min provides 24% to 44% oxygen concentration.

- BVM device (with oxygen reservoir) at 10 to 15 L/min provides 90% oxygen concentration.

Children need enough air to be delivered for adequate gas exchange in the lungs. Therefore, use of a nonrebreathing mask, a nasal cannula, or a simple face mask is indicated only for patients who have adequate respirations and/or tidal volumes. The tidal volume is the amount of air that is delivered to the lungs and airways in one inhalation. Children with respirations lower than 12 breaths/min or more than 60 breaths/min, an altered level of consciousness, and/or an inadequate tidal volume should receive assisted ventilations with a BVM device.

Blow-by oxygen is not as effective as a face mask or nasal cannula for delivering oxygen. In the blow-by technique, an oxygen tube is held near the infant or child's nose and mouth. It is often used after childbirth to deliver a small amount of oxygen to the newborn. On rare occasions when other adjuncts cannot be used or the child will not tolerate any other adjunct, this technique may be necessary.

Nonrebreathing Mask

A nonrebreathing mask delivers up to 90% oxygen to the patient and allows the patient to exhale all carbon dioxide without rebreathing it Figure 32-13 ▶. To apply a nonrebreathing mask:

1. **Select the appropriately sized** pediatric nonrebreathing mask. The mask should extend from the bridge of the nose to the cleft of the chin.
2. **Connect the tubing** to an oxygen source set at 10 to 15 L/min.
3. **Adjust oxygen flow** as needed to match the patient's respiratory rate and depth. The reservoir bag should neither deflate completely nor fill to bulging during the respiratory cycle.

Blow-by Technique

As mentioned, the blow-by technique does not provide a high concentration of oxygen but is better than no oxygen. To administer blow-by oxygen:

1. **Place oxygen tubing through a small hole in the bottom of a 6- to 8-oz paper cup** Figure 32-14 ▶. A cup is a familiar object that is less likely to frighten young children than an oxygen mask. You may be able to use an oxygen mask with an older child if you make it a game. For example, have the child pretend that the mask belongs to a popular action hero or an astronaut.
2. **Connect tubing to an oxygen source** set at 15 L/min.
3. **Hold the cup approximately 1″ to 2″ away from the child's nose and mouth.**

Figure 32-13 A pediatric nonrebreathing mask delivers up to 90% oxygen and allows the patient to exhale carbon dioxide without rebreathing it.

Figure 32-14 Blow-by techniques may be used when oxygen masks frighten children. Make a small hole in a 6- to 8-oz paper cup, or consider using a funnel inserted into the end of the oxygen tubing. Connect tubing to an oxygen source, and hold the cup about 2″ from the child's face.

Pediatric Needs

One of the problems associated with abdominal injuries in children is the presence of air in the stomach. Children, especially those who have had a traumatic injury, tend to swallow air. Air in the stomach can cause distention and interfere with your assessment. Air can also accumulate in the stomach with artificial ventilation, making it less effective. This is one of the reasons for using the jaw-thrust maneuver to position the airway, as it decreases the amount of air accumulating in the stomach.

Nasal Cannula

Some patients prefer this adjunct while others find it uncomfortable. To apply a nasal cannula:

1. **Choose the appropriately sized pediatric nasal cannula** Figure 32-15 ▼. The prongs should not fill the nares entirely. If the nares blanch, select a smaller cannula.
2. **Connect the tubing** to an oxygen source set at 1 to 6 L/min.

Figure 32-15 The prongs of a pediatric nasal cannula should not fill the nares entirely.

BVM Device

Assisting ventilations with a BVM device is indicated for patients who have respirations that are either too slow or too fast to provide an adequate volume of inhaled oxygen, who are unresponsive, or who do not respond in a purposeful way to painful stimuli.

Assist ventilation of an infant or child using a BVM device in the following way:

1. **Ensure that you have the appropriate equipment in the right size.** The proper size mask will extend from the bridge of the nose to the cleft of the chin, avoiding compression of the eyes Figure 32-16 ▼. The mask is transparent, so you can watch for cyanosis and vomiting. In addition, mask volume should be small to decrease dead space and avoid rebreathing; however, the bag should contain at least 450 mL of air. Use an infant bag, not a neonatal bag, for infants younger than 1 year; use a pediatric bag for children older than 1 year. Older children and adolescents may need an adult bag. Make sure that there is no pop-off valve on the bag; if the bag has a pop-off valve, make sure that you can hold it shut as necessary to achieve chest rise.
2. **Maintain a good seal** with the mask on the face.
3. **Ventilate at the appropriate rate and volume** using a slow, gentle squeeze, not a sharp, quick one.

Figure 32-16 Proper mask size for BVM ventilation is critical. The mask should extend from the bridge of the nose to the cleft of the chin, avoiding compression of the eyes.

One-rescuer BVM Ventilation on a Child

Skill Drill 32-4

1 Open the airway and insert the appropriate airway adjunct.

2 Hold the mask on the patient's face with a one-handed head tilt-chin lift technique (E-C grip). Ensure a good mask-face seal while maintaining the airway.

3 Squeeze the bag using the correct ventilation rate of 12 to 20 breaths/min. Allow adequate time for exhalation.

4 Assess effectiveness of ventilation by watching bilateral rise and fall of the chest.

Stop squeezing and begin to release the bag as soon as the chest wall begins to rise, indicating that the lungs are filled to capacity. To keep from ventilating too rapidly, use the phrase "squeeze, release, release." Say "squeeze" as you squeeze the bag; when you see the chest start to rise, release pressure on the bag and slowly say "release, release."

Errors in technique—providing too much volume with each breath, squeezing the bag too forcefully, or ventilating at too fast a rate—can result in gastric distention. An inadequate mask seal or improper head position can lead to hypoventilation or hypoxia. Even with the best technique in the world, the patient may regurgitate and aspirate the contents of his or her stomach.

One-rescuer BVM Ventilation

Perform one-rescuer BVM ventilation according to these steps (Skill Drill 32-4 ▲):

1. **Open the airway**, and insert the appropriate airway adjunct (**Step 1**).
2. **Hold the mask on the patient's face** by using the E-C grip. Form a C with the thumb and index finger along the mask while the other three fingers

form an E along the mandible. With infants and toddlers, support the jaw with only your third finger. Be careful not to compress the area under the chin, as you may push the tongue into the back of the mouth and block the airway. Keep fingers on the mandible.

3. **Make sure the mask forms an airtight seal** on the face. Maintain the seal while checking that the airway is open (**Step 2**).
4. **Squeeze the bag**, using the correct ventilation rate of 12 to 20 breaths/min.
5. **Each ventilation** (squeeze of the bag) should last 1 second (**Step 3**).
6. **Assess effectiveness** of ventilation by watching for adequate bilateral rise and fall of the chest (**Step 4**).

Two-rescuer BVM Ventilation

This procedure is similar to one-rescuer ventilation except that it requires two rescuers—one to hold the mask to the patient's face and maintain the patient's head position, the other to ventilate the patient. This technique is usually more effective in maintaining a tight seal.

Airway Obstruction

Children, especially those younger than 5 years, can (and do) obstruct their airway with any object that they can fit into their mouth: hot dogs, balloons, grapes, or coins Figure 32-17 ▼. In cases of trauma, a child's teeth may have been dislodged into the airway. Blood, vomitus, or other secretions can also cause mild or severe airway obstruction.

Figure 32-17 Any number of objects can obstruct a child's airway. Some of the more common ones include batteries, coins, toys, buttons, and candy.

Airway obstructions can also be caused by infections, including pneumonia, croup, and epiglottitis Figure 32-18 ▼. Croup is an infection of the airway below the level of the vocal cords, usually caused by a virus. Epiglottitis is an infection of the soft tissue in the area above the vocal cords. Infection should be considered as a possible cause of airway obstruction if a child has congestion, fever, drooling, and cold symptoms. Such children must be taken immediately to the emergency department. Without special equipment and training, attempts to clear an airway that is blocked by infection can worsen the obstruction.

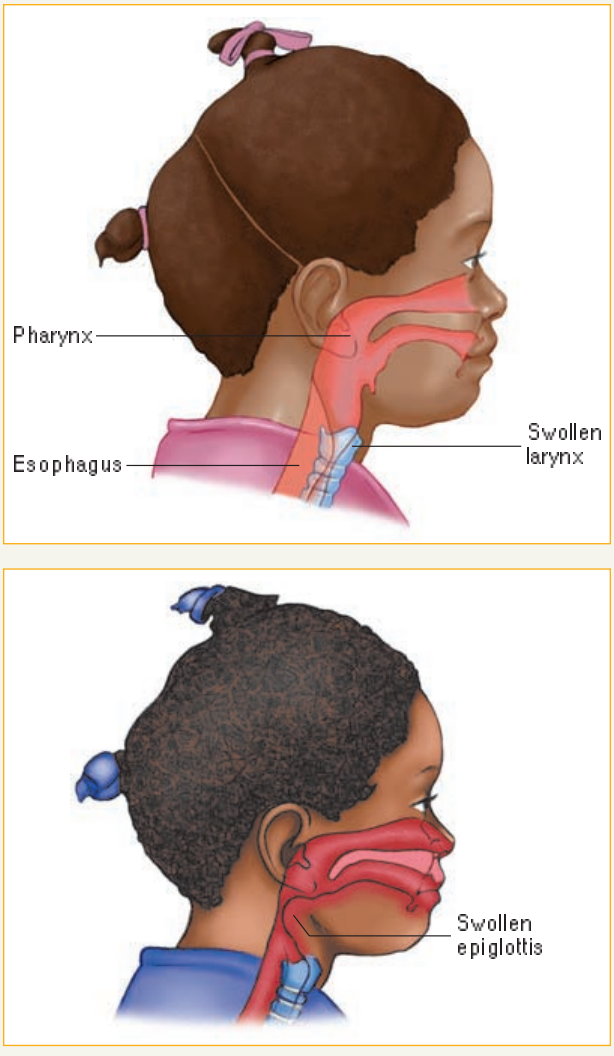


Figure 32-18 Epiglottitis is an infection that can cause airway obstruction in children.

Signs and Symptoms

Obstruction by a foreign object may involve the upper or the lower airway. Signs and symptoms that are frequently associated with an upper airway obstruction include decreased or absent breath sounds and stridor. Stridor, a high-pitched noise heard mainly on inspiration, is usually caused by swelling of the area surrounding the vocal cords or upper airway obstruction. In children with croup, it resembles the bark of a seal.

Signs and symptoms of a lower airway obstruction include wheezing, a whistling sound caused by air traveling through narrowed air passages within the bronchioles, and/or crackles. Crackles are caused by the flow of air through liquid, present in the air pouches and smaller airways in the lungs. They produce a crackling sound like that of blowing bubbles through a straw in a glass filled with liquid. The best way to auscultate breath sounds in a child is to listen on both sides of the chest at the level of the armpit Figure 32-19 ▼.

Emergency Medical Care

Treatment of the child with an airway obstruction must begin immediately. If the child is conscious and coughing forcefully and you know for sure that there is a foreign body in the airway—that is, if someone actually saw the object go into the child's mouth—encourage the child to cough to clear the airway. If the material in the airway does not completely block the flow of air, the child may be able to breathe adequately on his or her own without any intervention. In such cases, do not intervene except to provide supplemental oxygen Figure 32-20 ▼. Allow the child to remain in whatever position is most comfortable, and monitor his or her condition.

If you see signs of a severe airway obstruction, however, you must attempt to clear the airway at once. The signs include the following:

- Ineffective cough (no sound)
- Inability to speak or cry
- Increasing respiratory difficulty, with stridor
- Cyanosis
- Loss of consciousness

Management of Airway Obstruction in a Child

If there is reason to believe that an unconscious child has a foreign body obstruction, open the airway using the head tilt–chin lift and look inside the mouth to see whether the obstructing object is visible Figure 32-21 ▶. If the object is visible, try to remove it using a finger sweep motion. Never use finger sweeps if you cannot see the object, as you may push it further into the airway.

Figure 32-19 The best way to auscultate breath sounds in children is to listen on both sides of the chest at the level of the armpit.

Figure 32-20 If a child has a partial airway obstruction, do not intervene except to give supplemental oxygen and allow the child to remain in whatever position is most comfortable.

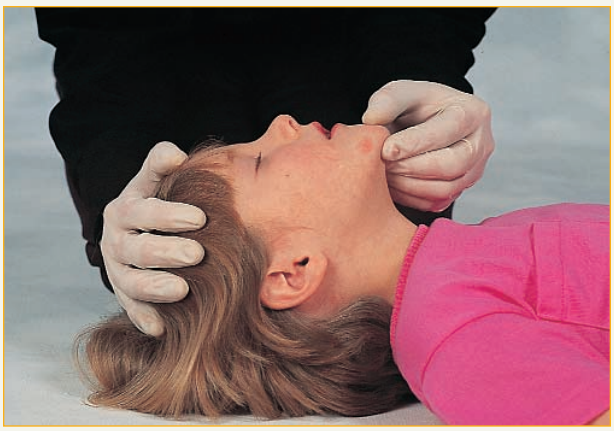


Figure 32-21 Open the airway and look inside the mouth of an unconscious child with a possible airway obstruction.

Chest compressions are recommended to relieve a severe airway obstruction in an unconscious child. Chest compressions increase the pressure in the chest, creating an artificial cough that may force a foreign body from the airway.

Skill Drill 32-5 ▶ demonstrates the steps for removing a foreign body airway obstruction in an unconscious child:

1. **Place the child in a supine position** on a firm, flat surface (**Step 1**).
2. **Open the airway using the head tilt–chin lift maneuver** and look inside the child's mouth (**Step 2**).
3. **Attempt rescue breathing.** If the first try is unsuccessful, reposition the child's head and try again (**Step 3**).
4. **If ventilation is still unsuccessful, begin CPR** (**Step 4**).
5. Place the heel of one hand on the lower half of the sternum between the nipples.
6. **Administer 30 chest compressions.** Compressions should be one third to one half the depth of the chest.
7. **Open the airway** using the head tilt–chin lift maneuver and look inside the child's mouth. If you see the object, remove it (**Step 5**).
8. Repeat the process starting at Step 3.

The following steps are used to remove a foreign body obstruction from a conscious child who is in a standing or sitting position Figure 32-22 ▶:

1. **Kneel on one knee behind the child**, and circle his or her body with both arms around the patient's chest. Prepare to give abdominal thrusts by placing your fist just above the patient's navel and well below the lower tip of the sternum. Place your other hand over that fist.
2. **Give the child abdominal thrusts** in an upward direction. Be careful to avoid applying force to the lower rib cage or sternum.
3. **Repeat this standing technique** until the child expels the foreign body or fully loses consciousness.
4. **If the child becomes unconscious**, position the child on a hard surface. Open the airway using the head tilt–chin lift maneuver and look inside the child's mouth. If you can see the foreign body, try to remove it.
5. **Attempt rescue breathing.** If the first attempt fails, reposition the head and try again.
6. **If the airway remains obstructed**, begin CPR.

You are the Provider — Part 3

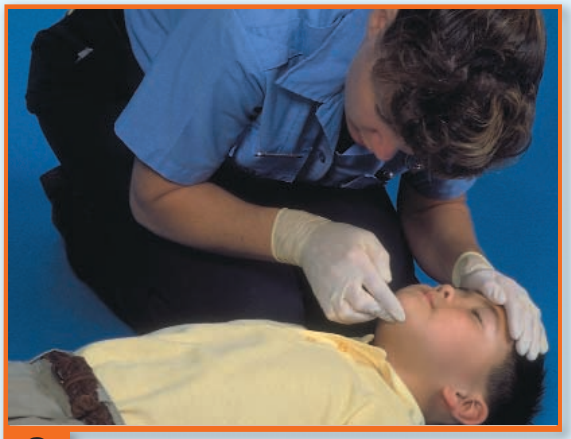
When you ask the mother to stop patting her on the back, Jamie stops coughing and gets a panicked look on her face. She appears to be gasping for breath with no air movement. You quickly move in to help the little girl. Your partner rushes out to the ambulance to retrieve your jump pack and to radio dispatch to let them know what is happening.

5. What has caused the child to stop coughing?
6. What are your treatment options for this patient?

Skill Drill 32-5

Removing a Foreign Body Airway Obstruction in an Unconscious Child

1 Position the child on a firm, flat surface.



2 Inspect the airway. Remove any foreign object that you can see.

3 Attempt rescue breathing. If unsuccessful, reposition the head and try again.

4 Locate the proper hand position on the chest of the child. If ventilation is still unsuccessful, begin CPR.

5 Administer 30 chest compressions and look inside child's mouth. If you see the object, remove it.

Figure 32-22 Kneel behind the child, wrap your arms around his or her body, and place your fist just above the navel and well below the lower tip of the sternum.

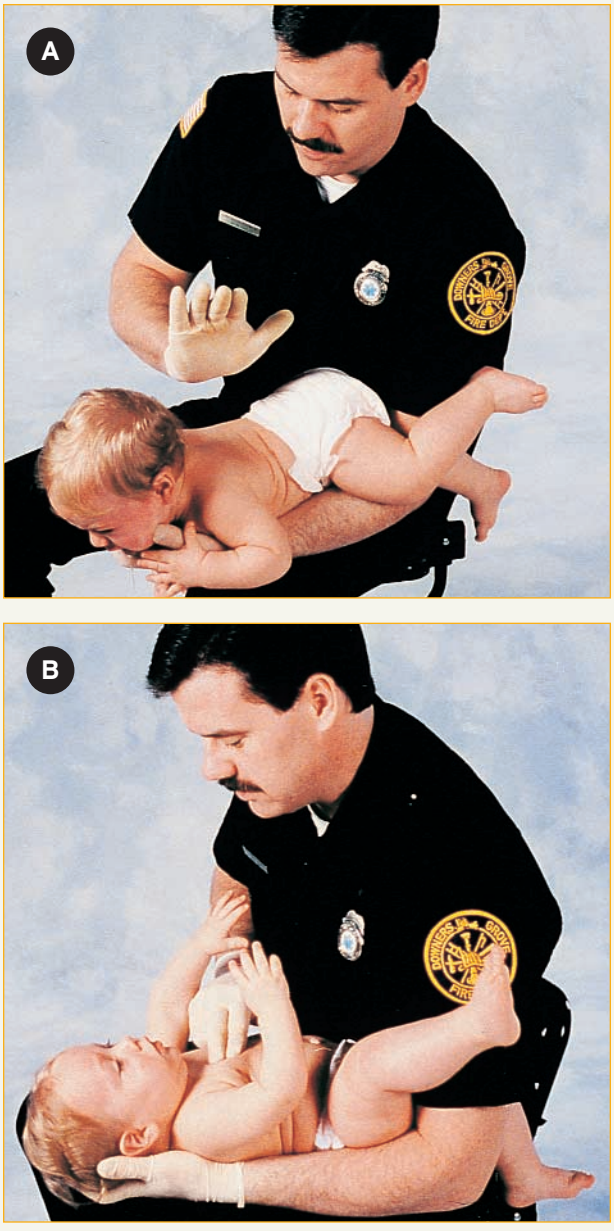


Figure 32-23 **A.** Hold the infant face down with the body resting on your forearm. Support the jaw and face with your hand, and keep the head lower than the rest of the body. Give the infant five back slaps between the shoulder blades, using the heel of your hand. **B.** Give the infant five quick chest thrusts, using two fingers placed on the lower half of the sternum.

If you manage to clear the airway obstruction in an unconscious child but he or she still has no spontaneous breathing or circulation, perform CPR.

Management of Airway Obstruction in an Infant

Abdominal thrusts are not recommended for conscious infants with an airway obstruction because of the risk of injury to the immature organs of the abdomen. Instead, perform back slaps and chest thrusts to try to clear a severe airway obstruction in a conscious infant, as follows (Figure 32-23 ▶):

1. **Hold the infant face down**, with the body resting on your forearm. Support the infant's jaw and face with your hand, and keep the head lower than the rest of the body.
2. **Deliver five back slaps** between the shoulder blades, using the heel of your hand.
3. **Place your free hand behind the infant's head and back**, and bring the infant upright on your thigh, sandwiching the infant's body between your two hands and arms. The infant's head should remain below the level of the body.
4. **Give five quick chest thrusts** in the same location and manner as chest compressions, using two fingers placed on the lower half of the sternum. For larger infants, or if you have small

hands, you can perform this step by placing the infant in your lap and turning the infant's whole body as a unit between back slaps and chest thrusts.

5. **Check the airway.** If you can see the foreign body now, remove it. If not, repeat the cycle as often as necessary.
6. **If the infant becomes unconscious,** begin CPR, remembering to look in the airway before ventilations each time.

If the infant regains consciousness, keep him or her in a position that allows for frequent reassessment of the airway and vital signs during transport. As you finish the initial assessment, you should have checked the child's level of consciousness, opened the airway, ventilated the child if needed, checked for circulation, and started CPR if required. If you have had to provide any additional treatments to maintain the child's ABCs, the child is a priority patient and transport should be initiated as soon as possible. Otherwise additional assessment is appropriate.

TABLE 32-5 Rescue Measures for a Newborn Who Is Not Breathing

Assess and support	■ Temperature (warm and dry) ■ Airway (position and suction) ■ Breathing (stimulate to cry) ■ Circulation (heart rate and color)
BLS interventions	■ Dry and warm the infant. ■ Clear the airway with a bulb syringe. ■ Stimulate the infant if he or she is unresponsive. ■ Use a BVM device to ventilate the newborn if needed. This is seldom required. ■ Perform chest compressions if there is no pulse or if the pulse rate is less than 60 beats/min despite oxygenation and ventilation.

Neonatal Resuscitation

At birth, most infants require resuscitation measures that stimulate the newborn to breathe air and begin circulation of blood through the lungs (Table 32-5 ▶). These measures include positioning of the airway, drying, warming, suctioning, and tactile stimulation. Here are some tips to help you maximize the effects of the measures:

- Position the infant on his or her back with the head down and the neck slightly extended. Place a towel or blanket under the infant's shoulders to help maintain this position.
- Suction the mouth and then nose using a bulb syringe or suction device with an 8- or 10-French catheter. Suction both sides of the back of the mouth, where secretions tend to collect, but avoid deep suctioning of the mouth and throat; this can cause the heart to slow down. Aim blow-by oxygen at the infant's mouth and nose during resuscitation.
- In addition to drying the infant's head, back, and body vigorously with dry towels, you may rub the infant's back and slap the soles of his or her feet.

In instances when a newborn is in distress, you should be properly equipped for resuscitation measures. All ambulances should have the following equipment and supplies for newborn resuscitation (Figure 32-24 ▼):

- A bulb syringe
- Clean, dry towels
- An infant blanket
- A BVM device with a 450-mL reservoir
- Clear masks in both infant and premature infant sizes
- 2 umbilical clamps
- Sterile 4 × 4 gauze
- A stocking cap
- An oxygen source with tubing

Figure 32-24 The proper equipment for neonatal resuscitation includes a bulb syringe, towels, an infant blanket, a BVM device, clear masks in two sizes, two umbilical clamps, sterile gauze, a stocking cap, and an oxygen source with tubing.

Additional Resuscitation Efforts

Observe the infant for spontaneous respirations, skin color, and movement of the extremities. If the respiratory effort appears appropriate, evaluate the heart rate by palpating the pulse at the base of the umbilical cord or at the brachial artery. The heart rate is the most important measure in determining the need for further resuscitation Table 32-6 ▼.

If chest compressions are required, give them at a rate of 120 times per minute, to a depth equal to one third to one half the depth of the chest. If two rescuers are present, the two-thumb hands-encircling technique should be used; the two-finger technique is appropriate to use if you are by yourself or if the infant is large Figure 32-25 ▼. Coordinate chest compressions and ventilations at a ratio of 3:1.

Any newborn who requires more than routine resuscitation requires transport, when possible, to a center with a Level III neonatal intensive care unit. This type of unit is designed for newborns who require specialized care, including mechanical ventilation.

About 12% of deliveries are complicated by the presence of meconium, a dark green material in the amniotic fluid. Meconium can be thick or thin. If the newborn aspirates thick meconium, serious lung disease and sometimes death can occur. Therefore, if you see meconium in the amniotic fluid or meconium staining, you should continue vigorous suctioning of the infant after delivery.

Basic Life Support Review

The reasons for cardiopulmonary arrest differ in children and adults. In adults, cardiac arrest is usually the result of an abnormal cardiac rhythm, which is itself caused by underlying cardiac disease. Because most children have healthy hearts, sudden cardiac arrest is

TABLE 32-6 Additional Neonatal Resuscitation Efforts

If the Heart Rate Is...	More Than 100 Beats/Min	60 to 100 Beats/Min	Fewer Than 60 Beats/Min
Do this:	Keep the newborn warm.	Begin assisted ventilation with a BVM device and 100% oxygen.	Begin assisted ventilation with a BVM device and 100% oxygen.
	Transport the newborn.	Reassess the newborn every 30 seconds until heart rate and respirations are normal.	Reassess the newborn every 30 seconds until heart rate and respirations are normal.
	Assess the newborn continuously.	Continue to reassess the infant. Call for ALS backup. Keep the newborn warm.	Begin chest compressions. Call for ALS backup. If the heart rate does not increase, medication and ALS will be needed.

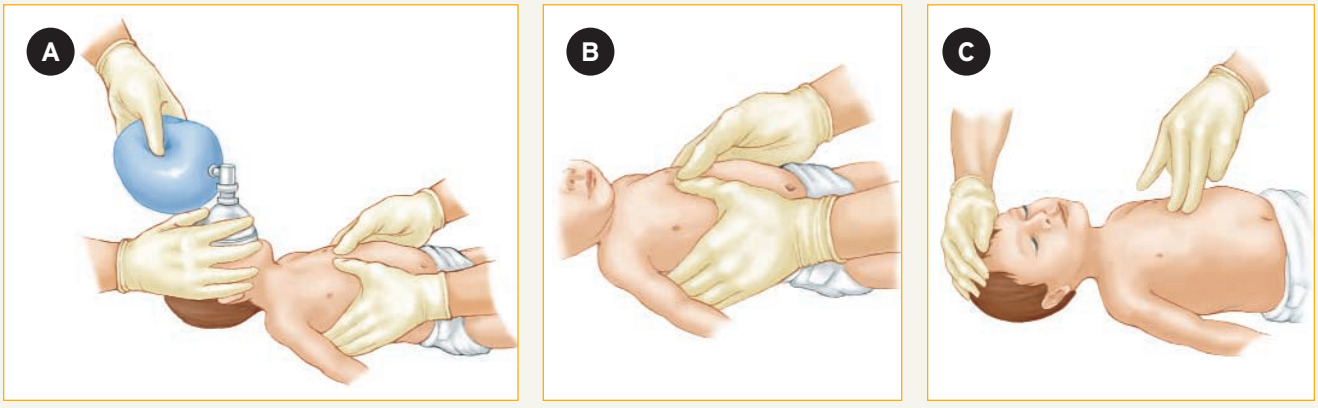


Figure 32-25 **A.** If two rescuers are present, use the two-thumb hands-encircling technique to perform chest compressions on the newborn. **B.** In very small infants, you may need to overlap the thumbs. **C.** If you are by yourself or if the infant is large, use your middle and ring fingers (two-finger technique).

rare. More commonly, children have cardiopulmonary arrest because of respiratory or circulatory failure from illness or injury. For this reason, the airway and breathing are the focus of pediatric basic life support (BLS) Table 32-7 ▼.

Respiratory problems leading to cardiopulmonary arrest in children can have a number of different causes, including:

- Injury, both blunt and penetrating
- Infections of the respiratory tract or another organ system
- A foreign body in the airway
- Near drowning
- Electrocution
- Poisoning or drug overdose
- Sudden infant death syndrome (SIDS)

For purposes of pediatric BLS, infancy ends at 1 year of age, and childhood extends through the onset of puberty. The goal, of course, is the same for all patients—to restore breathing and circulation of the blood.

Pediatric BLS can be divided into four steps:

1. Determining responsiveness
2. Airway
3. Breathing
4. Circulation

Determining Responsiveness

Never shake a child to determine whether he or she is responsive, especially if there is a possible neck or back injury. Instead, gently tap the child on the shoulder, and speak loudly Figure 32-26 ▼. If a child is responsive but struggling to breathe, allow him or her to remain in whatever position is most comfortable.

If you find an unresponsive, apneic, and pulseless child while you are alone and not on duty, perform CPR for approximately 2 minutes, and then stop to call the

Figure 32-26 Never shake a child to determine responsiveness. Rather, gently tap the child on the shoulder, and speak loudly.

TABLE 32-7 Review of Pediatric BLS Procedures

Procedure	Infants (younger than 1 y)	Children (1 y to onset of puberty)[1]
Airway	Head tilt-chin lift; jaw thrust if spinal injury is suspected	Head tilt-chin lift; jaw thrust if spinal injury is suspected
Breathing		
Initial breaths	2 breaths with duration of 1 second each with enough volume to produce chest rise	2 breaths with duration of 1 second each with enough volume to produce chest rise
Subsequent breaths	1 breath every 3 to 5 seconds (12 to 20 breaths/min)	1 breath every 3 to 5 seconds (12 to 20 breaths/min)
Circulation		
Pulse check	Brachial artery	Carotid or femoral artery
Compression area	Just below the nipple line	In the center of the chest, in between the nipples
Compression width	2 fingers or 2-thumb hands-encircling technique	Heel of one or both hands
Compression depth	One third to one half depth of chest	One third to one half depth of chest
Compression rate	100/min	100/min
Ratio of compressions to ventilations	30:2 (one rescuer); 15:2 (two rescuers)[2]	30:2 (one rescuer); 15:2 (two rescuers)[2]
Foreign body obstruction	Conscious: back slaps and chest thrusts Unconscious: CPR	Conscious: abdominal thrusts Unconscious: CPR

[1]Onset of puberty is approximately 12-14 years of age, as defined by secondary characteristics (eg, breast development in girls and armpit hair in boys).
[2]Pause compressions to deliver ventilations.

EMS system. Why not call right away, as you would with an adult? Because cardiopulmonary arrest in children is most often the result of respiratory failure, not a primary cardiac event. Therefore, they will require *immediate* restoration of oxygenation, ventilation, and circulation, which can be accomplished by *immediately* performing 5 cycles (about 2 minutes) of CPR before activating the EMS system.

Airway

Because children often put toys and other objects, as well as food, in their mouths, foreign body obstruction of the upper airway is common. The steps for removing a foreign object are reviewed earlier in this chapter. You must make sure that the upper airway is open when dealing with pediatric respiratory emergencies or cardiopulmonary arrest. If the child is unconscious and lying in a supine position, the airway may become obstructed when the tongue and throat muscles relax and the tongue falls backward Figure 32-27 ▼.

If the child is unconscious but breathing, place him or her on one side or the other in the recovery position, in which the upper leg is flexed and bent forward for stabilization and the head is positioned to allow drainage of saliva or vomitus Figure 32-28 ▶. Do not use this position if you suspect a spinal injury unless you can secure the child to a backboard that can be tilted to the side. Do not attempt to open the airway at all if the child is conscious and breathing, but in a labored fashion. Instead, provide immediate transport to the nearest hospital.

There are two common techniques for manually opening the airway in a child who is unconscious and not breathing: the head tilt-chin lift technique Figure 32-29 ▼ and the jaw-thrust maneuver. The jaw-thrust is safer if there is a possibility of spinal injury. Remember, however, that if the jaw-thrust does not adequately open the child's airway, *carefully* perform the head tilt-chin lift technique.

Head Tilt-Chin Lift Technique

Perform this technique in a child in the following manner:

1. **Place one hand on the child's forehead**, and tilt the head back gently, with the neck slightly extended.
2. **Place the fingers (not the thumb) of your other hand under the child's chin**, and lift the jaw upward and outward. Do not close the mouth or push under the chin; either move may obstruct rather than open the airway.
3. **Remove any visible foreign body or vomitus.**

Figure 32-28 A child who is unconscious but breathing should be placed in the recovery position to allow saliva or vomitus to drain from the mouth.

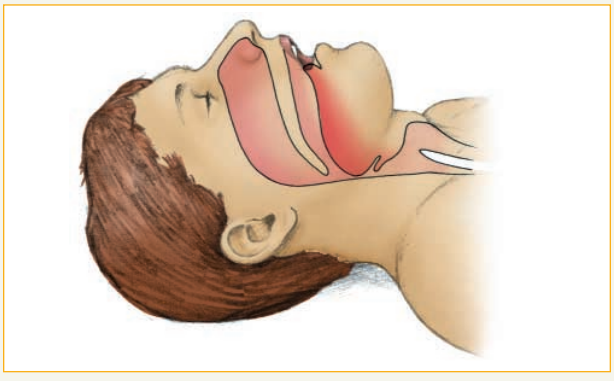


Figure 32-27 The airway may become obstructed when the tongue and throat muscles relax and the tongue falls back into the throat.

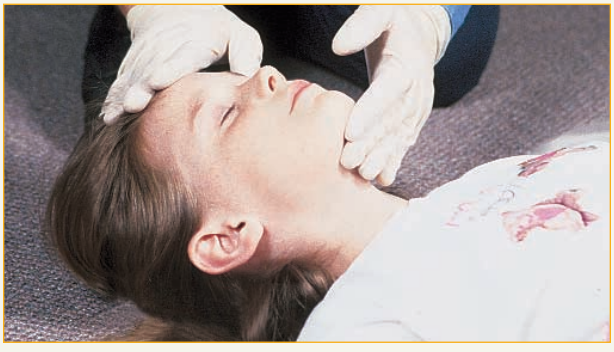


Figure 32-29 Use the head tilt-chin lift technique to open the airway in a child who has not sustained a traumatic injury. Do not overextend the neck.

Jaw-Thrust Maneuver

Perform this maneuver in a child in the following manner:

1. **Place two or three fingers** under each side of the angle of the lower jaw; lift the jaw upward and outward.
2. **If the jaw thrust alone** does not open the airway and cervical spine injury is not a consideration, tilt the head slightly. If cervical spine injury is suspected, use a second rescuer to immobilize the cervical spine.

Remember that the head of an infant or young child is disproportionately large in comparison to the chest and shoulders. As a result, when a child is lying flat on his or her back, especially on a backboard, the head will bend forward onto the upper chest. This can partially or completely obstruct the upper airway. To avoid this possibility, place a wedge of padding under the upper chest and shoulders.

Breathing

Once the airway is open, take at least 5 seconds but no more than 10 seconds to determine if the child is breathing spontaneously, using the look, listen, and feel technique Figure 32-30 ▶:

- **Look** for rise and fall of the chest or abdomen.
- **Listen** for exhalation of breath.
- **Feel** for exhaled air flow at the mouth.

If an infant or small child is breathing, provide immediate transport. Again, a child who is in respiratory distress should be allowed to stay in whatever position is most comfortable. Larger children who are unconscious and breathing with difficulty should be kept in the recovery position if possible.

If an infant or child is not breathing, provide rescue breathing while keeping the airway open. If you are using mouth-to-mouth resuscitation with an infant, place your mouth over the infant's mouth and nose to create a seal. If you are using a BVM device to assist ventilations in an infant, use the proper sized mask and the technique described earlier.

When two rescuers are available, use your thumb and index finger to apply pressure over the area just below the Adam's apple (the Sellick maneuver) Figure 32-31 ▼. This will decrease the risk of gastric

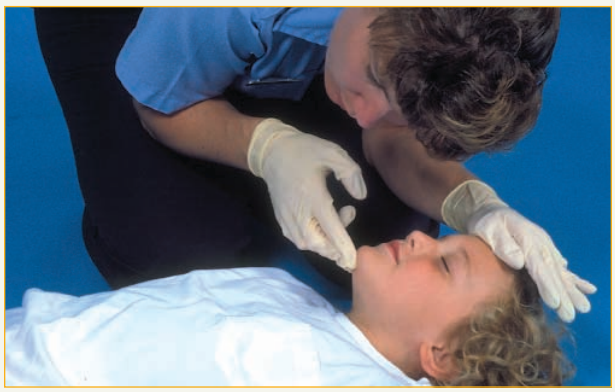


Figure 32-30 After you have opened the airway, use the look, listen, and feel technique to determine if the child is breathing spontaneously.

Figure 32-31 Performing the Sellick maneuver decreases the risk of gastric distention and aspiration of vomitus during BVM ventilation.

You are the Provider — Part 4

The mild airway obstruction has become a severe obstruction. You kneel behind the girl and wrap your arms around her. Finding the appropriate anatomic landmarks, you perform the Heimlich maneuver using forceful inward and upward motions.

7. How many times can you perform the Heimlich maneuver on a child?
8. If you are unsuccessful in alleviating the obstruction by using the Heimlich maneuver, what is your next step in treatment?

distention and aspiration of vomitus by pushing the larynx back to compress and close off the esophagus.

In a child with tracheostomy (breathing) tubes in the neck, remove the mask from the bag-valve device and connect it directly to the tracheostomy tube to ventilate the child. If a BVM device is unavailable, a mask, barrier device, or your mouth over the tracheostomy site can be used. Place your hand firmly over the child's mouth and nose to prevent the artificial breaths from leaking out of the upper airway.

Circulation

Once you have opened the airway and provided two rescue breaths, you assess the child's circulation. Check for pulses in the carotid or femoral arteries in children and the brachial artery in infants. Locate the carotid artery by placing one or two fingers over the groove between the Adam's apple and the neck muscles. The femoral artery can be felt in the crease between the upper leg and groin. Locate the brachial artery by placing two or three fingers on the inside of an infant's upper arm, between the elbow and the shoulder. Take at least 5 seconds but no more than 10 seconds to assess for a pulse. If the infant or child is not breathing, the pulse is often too slow (less than 60 beats/min) or absent altogether; therefore CPR will be required.

For chest compressions to be effective, the patient should be placed on a firm, flat surface with the head at the same level as the body. If you need to carry an infant while providing CPR, your forearm and hand can serve as the flat surface. Follow these steps to perform infant chest compressions Skill Drill 32-6 ▶:

1. **Place the infant on a firm surface**, using one hand to keep the head in an open airway position. You can also use a pad or wedge under the shoulders and upper body to keep the head from tilting forward.
2. Imagine a line drawn between the nipples. **Place two fingers in the middle of the sternum**, about ½″ below the level of the imaginary line (one fingerwidth) (**Step 1**).
3. **Using two fingers, compress the sternum** about one third to one half the depth of the chest. Compress the chest at a rate of 100 compressions/min.
4. **After each compression, allow the sternum to return briefly to its normal position.** Allow equal time for compression and relaxation of the chest. Do not remove your fingers from the sternum, and avoid jerky movements (**Step 2**).

Coordinate rapid compressions and ventilations in a 30:2 ratio, making sure the infant's chest fully recoils in between compressions and that the chest visibly rises with each ventilation. You will find this easier to do if you use your free hand to keep the head in the open airway position. If the chest does not rise, or rises only a little, use a chin lift to open the airway. Reassess the infant for signs of spontaneous breathing or pulses after 5 cycles (about 2 minutes) of CPR.

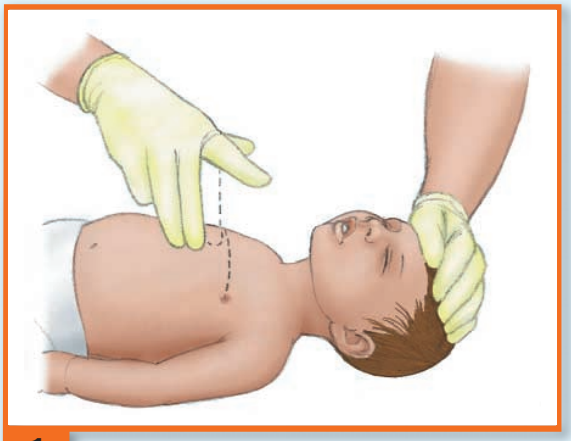
Skill Drill 32-7 ▶ shows the steps for performing CPR in children between 1 year of age and the onset of puberty:

1. **Place the child on a firm surface**, and use one hand to maintain the head in a tilted-back position (**Step 1**).
2. **Place the heel of one or two hands in the center of the chest, in between the nipples.** Avoid compression over the lower tip of the sternum, which is called the xiphoid process (**Step 2**).
3. **Compress the chest** about one third to one half the depth of the chest at a rate of 100 compressions/min. With pauses for ventilation, the actual number of compressions delivered will be about 80/min. In between compressions, allow the chest to fully recoil. Compression and relaxation time should be about the same duration. Use smooth movements. Hold your fingers off the child's ribs, and keep the heel of your hand(s) on the sternum.
4. **Coordinate rapid compressions and ventilations** in a 30:2 ratio for one rescuer and 15:2 for two rescuers, making sure the chest rises with each ventilation. At the end of each cycle, pause for two ventilations (**Step 3**).
5. **Reassess the child for breathing and pulses** after every five cycles (about 2 minutes) of CPR.
6. **If the child resumes effective breathing**, place him or her in a position that allows for frequent reassessment of the airway and vital signs during transport (**Step 4**).

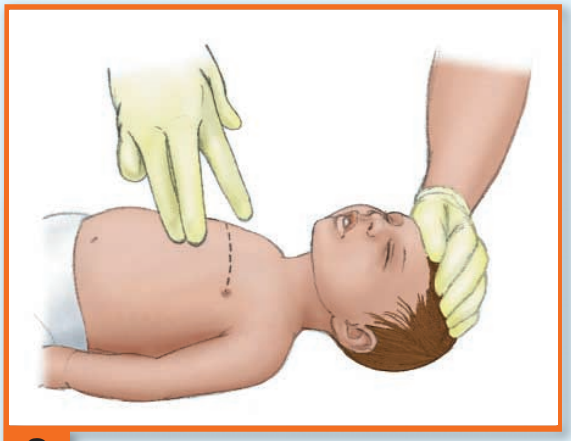
Remember, if the child is past the onset of puberty, use the adult CPR sequence, including the use of the AED.

Performing Infant Chest Compressions

Skill Drill 32-6



1 Position the infant on a firm surface while maintaining the airway. Place two fingers in the middle of the sternum just below a line between the nipples.



2 Use two fingers to compress the chest one third to one half its depth at a rate of 100 times/min.

Allow the sternum to return to its normal position between compressions.

AED Usage in Children

Cardiac rhythms that require defibrillation can be the cause of sudden cardiac arrest (SCA) or may develop during resuscitation attempts. According to the American Heart Association, AEDs can safely be used in children older than 1 year of age. When using an AED on a child between 1 and 8 years of age, you should use pediatric-sized pads and a dose-attenuating system (energy reducer). However, if these are not available, an adult AED should be used. The AED is not indicated for use in infants less than 1 year of age. During CPR, the AED should be applied to children over 1 year of age after the first five cycles of CPR have been completed. As discussed earlier, cardiac arrest in children is usually due to respiratory failure; therefore, oxygenation and ventilation are vitally important. After the first five cycles of CPR, the AED should be used to deliver shocks in the same manner as with an adult patient.

EMT-B Tips

An injured child with serious airway or breathing problems is likely to need full-time attention from two EMT-Bs. The need for a driver, and often for added help with patient care, makes it important to start arranging early for backup from another unit—possibly even before you arrive at the scene.

EMT-B Tips

AEDs are becoming more and more accessible in the community. Be familiar with your local protocols on pediatric defibrillation. Your service may use a pediatric AED, or an AED with a pediatric adapter.

Skill Drill 32-7

Performing CPR on a Child

1 Place the child on a firm surface, open the airway, and deliver two rescue breaths.

2 Place the heel of one or both hands in the center of the chest, in between the nipples, avoiding the xiphoid process.

3 Compress the chest one third to one half the depth of the chest at a rate of 100 times/min. Coordinate compressions with ventilations in a 30:2 ratio (one rescuer) or 15:2 (two rescuers), pausing for ventilations.

4 Reassess for breathing and pulse after every 5 cycles (about 2 minutes) of CPR. If the child resumes effective breathing, place him or her in a position that allows for frequent reassessment of the airway and vital signs during transport.

Cardiopulmonary Arrest

Cardiac arrest in infants and children is most often associated with respiratory failure and respiratory arrest. Children are affected differently than adults when it comes to decreasing oxygen concentrations. An adult becomes hypoxic and the heart gets irritable and sudden cardiac death occurs. This is often in the form of ventricular fibrillation, and is the reason that an AED is the treatment of choice. Children, on the other hand, become hypoxic and their hearts slow down, becoming more and more bradycardic. The heart will beat slower and become weaker with each beat until no pulse is felt. The survival rate from cardiac arrest in the prehospital setting is 3% to 5%. However, the survival rate from respiratory arrest is 75%. Therefore a child who is breathing very poorly with a slowing heart rate must be ventilated with high concentrations of

oxygen early to try to oxygenate the heart before cardiac arrest occurs.

Pediatric Trauma

The trauma assessment of a child follows the same format of the adult's; however, several differences make the child more prone to injury. Once the MOI has been determined and the child's level of consciousness assessed, the EMT-B must determine whether to use a focused or head-to-toe exam. Remember that young children cannot be specific about location or severity of pain, thus requiring the EMT-B to do a head-to-toe exam anyway.

When beginning the exam, determine the age of the child. Infants, toddlers, and preschool-age children do not like to be touched. If possible, the exam should start from the toes and move toward the head, leaving any noticeably injured areas for last. Starting at the core may make the child irritable and less likely to assist with your exam.

The head is injured most often and is the most likely injury to cause death. The child's head is large in comparison to the body, and most multisystem trauma will involve the head. During your assessment, concentrate on keeping the airway open as noted earlier. Monitor vital signs often to look for signs of increased intercranial pressure. Hyperventilation should be avoided until normal ventilations have been established and signs of herniation are present.

Cervical spine injury is more prevalent in children than in adults due to the weaker muscles of the neck. This is one of the reasons that children younger than 1 year should always be in a rear-facing car seat when being transported. Careful immobilization should be used to maintain a neutral position as described earlier.

Immobilization

Immobilization is necessary for all children who have possible head or spinal injuries after a traumatic event. Follow these steps (Skill Drill 32-8 ▶):

1. **Maintain the child's head in a neutral position** by placing a towel under the shoulders and torso (**Step 1**).
2. **Place an appropriately sized cervical collar on the patient** (**Step 2**).
3. **Carefully log roll the child** onto the immobilization device (**Step 3**).
4. **Secure the patient's torso** to the immobilization device first (**Step 4**).
5. **Secure the child's head** to the immobilization device (**Step 5**).
6. **Complete immobilization** by ensuring that the child is strapped in properly (**Step 6**).

Immobilization can be difficult to perform due to the child's body proportions. Young children require padding under the torso to maintain a neutral position. At around 8 to 10 years of age, children no longer require padding underneath the torso to create a neutral position. Instead, they can simply lie supine on the board. However, another complication may occur if a child is put onto an adult-sized long board. Because a child's body is narrower than an adult's, padding will be required along the sides in order for the child to be properly secured on an adult-sized long board.

Some infants will be in a car seat when the EMT-B approaches them. There are two methods of transportation that are determined by the patient's severity. If the child has stable vital signs, minimal injury, and the car seat is visibly undamaged, the child can be left in the seat and secured within it for transportation. If the child is unstable, has injuries other than minor ones, or the car seat is visibly damaged, the child must be removed to a board type of device for immobilization and transportation.

Ideally, a cervical collar would be used when immobilizing an infant or toddler in a car seat; however, in most instances an appropriately sized cervical collar will not be available. In this case, place rolled towels on either side of the head to prevent side-to-side movement. Do not place a towel in the shape of an upside-down "U" over the child's head; this may press down on the head and compromise the airway and spinal cord. The steps for immobilizing an infant in a car seat follow (Skill Drill 32-9 ▶):

1. **Carefully stabilize the infant's head in a neutral position.** Leave all car seat straps in place (**Step 1**).
2. **Place an appropriately sized cervical collar on the patient** if available. **Otherwise, place rolled towels or padding alongside the infant** to fill the voids in the car seat (**Step 2**).
3. **Carefully secure the padding, using tape to keep it in place** (**Step 3**).
4. **Secure the car seat to the stretcher** as detailed later in this chapter (**Step 4**).

Skill Drill 32-8

Immobilizing a Child

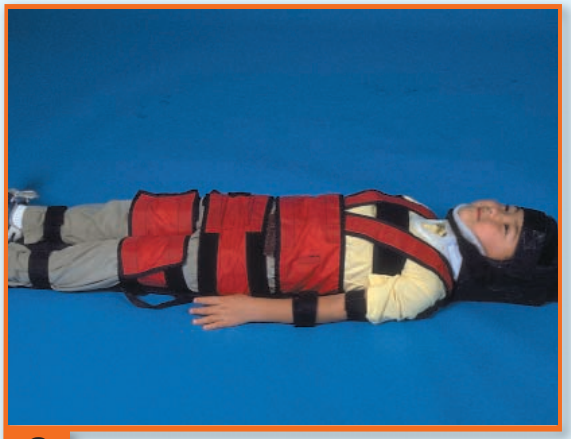
1 Use a towel under the back, from the shoulders to the hips, to maintain the head in a neutral position.

2 Apply an appropriately sized cervical collar.

3 Log roll the child onto the immobilization device.

4 Secure the torso first.

5 Secure the head.



6 Ensure that the child is strapped in properly.

Skill Drill 32-9

Immobilizing an Infant in a Car Seat

1 Carefully stabilize the infant's head in a neutral position.

2 Place an appropriately sized cervical collar on the patient if available. Otherwise, place rolled towels or padding alongside the infant.

3 Carefully secure the padding, using tape to keep it in place.

4 Secure the car seat to the stretcher.

Follow these steps to immobilize an infant out of a car seat (Skill Drill 32-10 ▶):

1. **Carefully stabilize the infant's head in a neutral position** and lay the seat down into a reclined position on a hard surface (**Step 1**).
2. **Position a pediatric board or other similar device** between the patient and the surface on which the infant is resting (**Step 2**).
3. **Carefully slide the infant into position** on the board (**Step 3**).
4. **Make sure the infant's head is in a neutral position** by placing a towel under the infant's shoulders (**Step 4**).
5. **Secure the torso first** and place padding to fill any voids (**Step 5**).
6. **Secure the infant's head** to the board (**Step 6**).

Skill Drill 32-10

Immobilizing an Infant Out of a Car Seat

1 Stabilize the head in neutral position.

2 Place an immobilization device between the patient and the surface he or she is resting on.

3 Slide the infant onto the board.

4 Place a towel under the back, from the shoulders to the hips, to ensure neutral head position.

5 Secure the torso first; pad any voids.

6 Secure the head.

Management of Pediatric Injuries

Extremity injuries in children are generally managed in the same manner as those in adults. Painful deformed limbs with evidence of broken bones should be splinted. Specialized splinting equipment, such as a traction splint for fractures of the femur, should be used only if it fits the child. You should not attempt to use adult immobilization devices on a child unless the child is large enough to properly fit in the device.

Pediatric Medical Emergencies

Like the pediatric trauma assessment, the pediatric medical assessment follows the same pathways as in the adult, with emphasis on the differences in the pediatric patient. Some medical complaints merit additional discussion.

Respiratory Emergencies

In the early stages of respiratory distress or failure, respirations may be too slow or too fast for the patient's age. This suggests that gases are not moving effectively into and out of the lungs. If like most people you find it hard to memorize normal vital sign ranges for infants and children, keep reference charts handy for this purpose. Respirations exceeding 60 breaths/min are a sign of a problem. In most cases, you should begin to assist ventilation immediately, even if the child appears to be breathing adequately. But remember, you are treating the child, not the numbers. A child breathing 40 breaths/min who is playing happily does not need assisted ventilation; a child breathing 40 breaths/min who is lying unconscious on the floor does.

Signs and Symptoms

In the early stages of respiratory distress, you may note changes in the child's behavior, such as combativeness, restlessness, and anxiety. As the body attempts to maximize the amount of air going into the lungs, the work of breathing increases. Signs and symptoms of increased work of breathing include:

- Nasal flaring, as the body tries to increase the size of the airway
- Grunting respirations, as the body attempts to keep the alveoli expanded at the end of expiration
- Wheezing, stridor, or other abnormal airway sounds
- Accessory (intercostal) muscle use; remember that in young children, the diaphragm is the major muscle of ventilation
- Retractions, or movements of the child's flexible rib cage
- The tripod position; in older children, this position will maximize their airway.

You are the Provider — Part 5

You continue performing the Heimlich maneuver with no success. The little girl becomes unconscious. You quickly lay her down on the ground and begin delivering abdominal thrusts. Your partner performs a head tilt-chin lift in an effort to try to visualize the obstruction. While doing so, you continue doing abdominal thrusts. Suddenly a chunk of food shoots out of Jamie's mouth. She gasps for air.

9. Can you perform a blind finger sweep on a child?
10. What is the normal breathing rate for children?

As the child progresses to possible respiratory failure, efforts to breathe decrease; the chest rises less with inspiration. A definitive diagnosis of respiratory failure is made in the hospital. The body has used up its available energy stores and cannot continue to support the extra work of breathing under these conditions. At this point, cyanosis may develop (cyanosis is a late sign). Be aware that not all children become cyanotic. You should be just as concerned about a child with pale skin as one with bluish skin.

Changes in behavior will also occur until the child demonstrates an altered level of consciousness. The patient may experience periods of apnea (absence of breathing). As the lack of oxygen becomes more serious, the heart muscle itself becomes hypoxic and slows down. This leads to bradycardia, a condition in which the heart rate is less than 80 beats/min in children or less than 100 beats/min in newborns. Bradycardia is almost always an ominous sign in pediatric patients. If the heart rate is fast, you need to investigate the cause. However, if the heart rate is slow (less than 60 beats/min) or absent, especially in an unconscious infant or child, you must begin CPR immediately. Without aggressive airway management, bradycardia may quickly progress to cardiopulmonary arrest.

Of course, respiratory failure does not always indicate airway obstruction. It may indicate trauma, problems with the nervous system, dehydration (often caused by vomiting and diarrhea), or metabolic disturbances. For example, a child with diabetes might have a blood glucose level that is too high or too low; a child might have a pH imbalance, as can happen with some rare childhood diseases. Regardless of the cause, your first step is always to focus on ensuring adequate oxygenation and ventilation.

Never forget that a child can progress from respiratory distress to respiratory failure at any time. For this reason, you must reassess the child frequently.

Emergency Medical Care

A child or infant in respiratory distress or possible respiratory failure needs supplemental oxygen. Remember, anxiety, agitation, or crying may increase the effort or work of breathing, so use whichever method seems least upsetting to the child—mask, blow-by, or nasal cannula (Figure 32-32 ▶). You may need to get creative by distracting the child with games, a toy, or talking.

Allow the child to remain in a comfortable position. For a small child, this may mean sitting on the caregiver's lap. Give nothing by mouth, in case the child's condition deteriorates suddenly.

Figure 32-32 A child in respiratory distress needs supplemental oxygen; you should select whichever method seems least upsetting to the child.

If the patient has progressed to respiratory failure, you must begin assisted ventilation immediately and continue to provide supplemental oxygen.

Shock

As discussed in Chapter 23, 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:

- 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, increasing respirations, and showing signs of pale or blue skin. You must be able to recognize the signs of shock in infants and children.

Loss of more than 25% blood volume significantly increases the risk of shock. Signs of shock in children are:

- Tachycardia
- Poor capillary refill
- Mental status changes

For comparison, signs of shock in adults are:

- Tachycardia
- Hypotension
- Mental status changes

Greater than 30% to 40% blood volume loss significantly increases risk of shock in adults.

Begin by assessing the ABCs, intervening immediately as required; do not wait until you have completed a detailed assessment 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?
- **CRT.** Squeeze a finger or toe for several seconds until the skin blanches, then release it. 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 CRT are all important clues suggesting shock.

Blood pressure is the most difficult vital sign to measure in pediatric patients. The cuff must be the proper size—two thirds the length of the upper arm. The value for normal blood pressure is also age-specific. Remember that blood pressure may be normal; this is called compensated shock. Low blood pressure 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 parents or 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?)
- Absence of tears, even when the child is crying
- Changes in level of consciousness and behavior

Limit your management to these simple interventions. Time should not be wasted in field procedures. Ensure that the airway is open, preparing for artificial ventilation; control bleeding; and give supplemental oxygen by mask or blow-by method as tolerated. Continue to monitor airway and breathing. Position the patient with the head lower than the feet by elevating the feet with blankets. Keep the patient warm with blankets and by turning up the heat in the patient compartment. Provide immediate transport to the nearest appropriate facility and continue monitoring vital signs en route. Contact ALS backup as needed. Allow a caregiver to accompany the child whenever possible.

Seizures

Seizures in children may appear in several different ways, including shaking of the whole body or movement in just a single arm or leg. Seizures can also appear as lip smacking, eye blinking, or staring off into space. In a true seizure, movements cannot be stopped on command or by holding an extremity. The duration of movement varies from patient to patient.

Altered mental status and the inability of others to stop a movement or range of movements in the affected limb are common to all seizures. Some patients may feel pins and needles, hear sounds, and see hallucinations. In all but absence seizures (discussed in Chapter 13), a postictal period of extreme fatigue or unresponsiveness occurs after the seizure for anywhere from a few minutes to several hours. During this time, the patient may appear sleepy and/or confused and is not able to interact appropriately. A short period of seizure activity (under 30 minutes) is not in itself harmful to the patient. After 30 to 45 minutes, however, the brain may run low on energy stores, and continued activity can be harmful. Status epilepticus is a continuous seizure, or multiple seizures without a return to consciousness, for 30 minutes or more.

If you can identify the cause of the seizure, you will be better able to monitor the patient for any potential complications associated with the underlying problem.

In particular, be alert to the presence of medications, possible poisons, and indications of abuse or neglect.

Febrile Seizures

Febrile seizures are common in children between the ages of 6 months and 6 years. Most pediatric seizures are due to fever alone, which is why they are called febrile seizures. These seizures typically occur on the first day of a febrile illness, are characterized by generalized tonic-clonic seizure activity, and last less than 15 minutes with a short postictal phase or none at all. They may be a sign of a more serious problem, such as meningitis. Obtain a history from the caregivers, as these children may have had a prior febrile seizure.

If you are called to care for a child who has had a febrile seizure, you often will find that the patient is awake, alert, and fully interactive when you arrive. Keep in mind that a persistent fever can lead to another seizure. Carefully assess the ABCs, begin cooling measures with tepid (not cold) water, and provide prompt transport; all children with febrile seizures need to be seen in the hospital setting.

Emergency Medical Care

Although medical management of seizures in the hospital setting may vary according to cause, your assessment and management of these patients remain essentially the same. First, ensure that the scene is safe for you and your partner and for the patient. Next, perform an initial assessment, focusing on the ABCs. If possible, obtain a brief history from the caregivers about previous serious illnesses or seizures and current medication or trauma.

Securing and protecting the airway are your priorities. To avoid obstruction from the tongue falling back into the airway, place a child who is having a seizure or who is postictal in the recovery position if you can do so without having to use extreme force against the seizure activity. In the case of trauma, place the head in a neutral in-line position and ensure that the cervical spine is protected. Be ready to use suction to prevent aspiration of stomach contents, blood, or vomitus. Do not place your fingers in the mouth of a patient who is having a seizure.

A patient who is actively seizing or who is postictal may not be breathing adequately. Assessing the rate and depth of respirations in this situation can be difficult but is essential. Patients may have shallow, rapid breathing or may have occasional deep respirations. Signs that a patient is not breathing adequately include:

- Very slow respirations
- Very shallow breaths
- Bluish tint to lips or pale lips
- Snoring respirations caused by the tongue blocking the airway

Deliver oxygen by mask, blow-by, or nasal cannula. If there are no signs of improvement, begin BVM ventilation with appropriately sized equipment.

Patients who are experiencing a seizure usually maintain adequate blood pressure and pulse rate unless the seizure is caused by an underlying circulatory or neurologic problem or trauma, including bleeding, heart problems, or brain injury. Nevertheless, you must evaluate the pulse and blood pressure and re-evaluate them. Once the ABCs have been addressed, assessment and management should proceed. If the patient is actively seizing, note the type of movement and position of the eyes, as this information may be very helpful to hospital staff in making a diagnosis. If there is a fever, begin cooling measures such as removing clothing and placing towels moistened with tepid water on the child. A child with febrile seizures can seize again if the temperature remains high. Do not use alcohol or cold water to cool a patient. Make sure the patient is protected from hitting the sides of the stretcher or nearby equipment. Bring any medications or possible poisons at the scene to the hospital with the patient. If the patient is in status epilepticus, call for ALS backup, as medication is required to stop the seizures.

Dehydration

Dehydration can be described as mild, moderate, or severe. The severity of the dehydration can be gauged by looking at several clues Table 32-8 ▶. For example, an infant with mild dehydration may have dry lips and gums, decreased saliva, and fewer wet diapers throughout the day Figure 32-33 ▶. As the dehydration grows more severe, the lips and gums may become very dry, the eyes may look sunken, and the infant may be sleepy and/or irritable, refusing bottles. The skin may be loose and have no elasticity; this is called poor skin turgor. Also, infants may have sunken fontanels.

Young children can compensate for fluid losses by decreasing blood flow to the extremities and directing it to vital organs such as the brain and heart. Children who are moderately to severely dehydrated

TABLE 32-8 Vital Signs and Symptoms of Dehydration

	Mild Dehydration	Moderate Dehydration	Severe Dehydration
Pulse	Normal	Increased	Increased; 160+ is sign of impending shock
Level of activity	Normal or slowed	Slowed	Variable, weak to unresponsive
Urine output	Decreased	Decreased	No output
Skin	Normal	Cool, mottled; poor turgor	Cool, clammy; poor turgor; delayed CRT
Mouth	Decreased saliva	Dry mucous membranes	Dry mucous membranes
Eyes	Normal	Tears	Sunken eyes
Anterior fontanel	Normal to sunken	Sunken	Very sunken
Level of consciousness	Normal	Altered	Altered; lethargic
Blood pressure	Normal	Normal	Normal to low when shock sets in

may have mottled, cool, clammy skin and delayed CRT. Respirations will usually be increased. Be aware that blood pressure may remain normal while the child is in shock.

Emergency medical care should include careful attention assessing the ABCs and obtaining baseline vital signs. However, if the dehydration is severe, ALS backup may be necessary so that IV access can be obtained and rehydration can begin. All children with signs and symptoms of moderate to severe dehydration should be transported to the emergency department.

Figure 32-33 An infant with dehydration may exhibit "tenting" or poor skin turgor.

You are the Provider — Summary

You immediately apply high-flow oxygen and begin monitoring her breathing status. Within moments Jamie is breathing normally. She is conscious, alert, and oriented to person, time, place, and event. You offer to transport Jamie to the hospital for observation but her mother refuses, stating that she is ok now. After completing the necessary paperwork and notifying dispatch of your status, you and your partner return to your table to finish your lunch before you receive your next call.

As an EMT-B you will find that you are more aware of your surroundings and those around you. Always ensure that you have consent prior to treating any patient. Make checking the airway, breathing, and circulation your first step in the treatment of every patient. Remember, no airway, no patient.

Prep Kit

Ready for Review

- You will need to carry special sizes of airway equipment for pediatric patients.
- Use a pediatric resuscitation tape measure to determine the appropriately sized equipment for children.
- Use the pediatric assessment triangle (PAT) to obtain a general impression of the infant or child.
- In treating possible respiratory failure in a child, always position the airway in a neutral position.
- Appropriate oxygen delivery devices include the blow-by technique at 15 L/min, a nasal cannula at 1 to 6 L/min, a nonrebreathing mask at 10 to 15 L/min, and a BVM device at 10 to 15 L/min.
- Use a BVM device with a child whose breathing and tidal volume are inadequate and who has an altered level of consciousness.
- The three keys to successful use of the BVM device in a child are: (1) have the appropriate equipment in the right size; (2) maintain a good face to mask seal; and (3) ventilate at the appropriate rate and volume—12 to 20 breaths/min for an infant or child, 1 second per ventilation. Squeeze gently, and stop squeezing as the chest wall begins to rise; use the phrase "squeeze, release, release" to maintain a proper rhythm.
- Children younger than 5 years often obstruct their upper and lower airway with a variety of foreign objects.
- If the child is conscious, encourage him or her to cough to clear the airway.
- If the child is unresponsive, you should first use the head tilt–chin lift to try to remove an object that you can see.
- In treating an unresponsive child with severe airway obstruction, perform chest compressions, alternating with opening the airway and visualizing the mouth, and attempts to ventilate.
- In a conscious child who is sitting or standing, stand or kneel behind the patient and perform abdominal thrusts until the obstruction is relieved or the child loses consciousness. In a conscious infant, perform back slaps and chest thrusts.
- Signs of shock in children are tachycardia, poor CRT, and mental status changes. You must be very alert for signs of shock in a child because children decompensate rapidly.
- Febrile seizures are common in children between the ages of 6 months and 6 years. Most pediatric seizures are due to fever alone, which is why they are called febrile seizures. Treat as you would for an adult patient with a seizure. Carefully assess the ABCs, begin cooling measures, and provide prompt transport.
- The most common cause of dehydration in children is vomiting and diarrhea. Life-threatening diarrhea can develop in an infant in hours. You can determine whether a child's dehydration is mild, moderate, or severe by assessing the child's urine output, level of activity, mental status, skin tone, and pulse.
- BLS for infants and children consists of determining responsiveness and assessing airway, breathing, and circulation.
- If the child is unresponsive but breathing, place him or her in the recovery position unless you suspect a spinal injury. Use the head tilt-chin lift or jaw-thrust maneuver to open the airway in a child who is unresponsive and not breathing.

Technology

- Interactivities
- Vocabulary Explorer
- Anatomy Review
- Web Links
- Online Review Manual

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- If an infant or child is not breathing, provide rescue breathing while keeping the airway open. Rescue breaths for infants and children are delivered over a period of 1 second each, at a rate of 12 to 20 breaths/min (1 breath every 3 to 5 seconds).
- To provide CPR in an infant, use a compression to ventilation ratio of 30:2 if you are alone; 15:2 if two rescuers are present. Use two fingers to compress the lower half of the sternum to a depth that is one third to one half the depth of the chest at a rate of 100 compressions/min.
- In children, use the same depth, rate, and ratio of compressions to ventilations as you did for the infant; however, use the heel of one or both hands to compress the chest; avoid compressing the xiphoid process.

Vital Vocabulary

anemia A deficiency of red blood cells or hemoglobin.

apnea Absence of breathing.

AVPU scale Used to assess level of consciousness; recorded as being alert, verbally responsive, responsive to pain, or unresponsive.

blanching Turning white.

bradycardia A heart rate of less than 80 beats/min in children or less than 100 beats/min in infants.

bradypnea Slow respiratory rate; ominous sign in a child that indicates impending respiratory arrest.

capillary refill time (CRT) The amount of time that it takes for blood to return to the capillary bed after applying pressure to the skin or nailbed; indicates the status of end-organ perfusion; reliable in children younger than 6 years.

central pulses Pulses that are closest to the core (central) part of the body where the vital organs are located; include the carotid, femoral, and apical pulses.

crackles A crackling breath sound caused by the flow of air through liquid in the lungs; a sign of lower airway obstruction.

croup Infection of the airway below the level of the vocal cords, usually caused by a virus.

cyanosis A blue discoloration of the skin and mucous membranes; indicates decreased levels of oxygen in the blood.

end-organ perfusion The status of perfusion to the vital organs of the body; determined by assessing capillary refill time (CRT).

epiglottitis An infection of the soft tissue in the area above the vocal cords.

grunting An "uh" sound heard during exhalation; reflects the child's attempt to keep the alveoli open; a sign of increased work of breathing.

head bobbing The head lifts and tilts back during inspiration, then moves forward during expiration; a sign of increased work of breathing.

meconium A dark green material in the amniotic fluid that can cause lung disease in the newborn.

nares The external openings of the nostrils. A single nostril opening is called a naris.

nasal flaring Widening of the nares during inspiration; commonly seen in infants; indicates increased work of breathing.

pediatric assessment triangle (PAT) A structured assessment tool that allows you to rapidly form a general impression of the infant or child without touching him or her; consists of assessing appearance, work of breathing, and circulation to the skin.

pediatric resuscitation tape measure A tape used to estimate an infant or child's weight on the basis of length; appropriate drug doses and equipment sizes are listed on the tape.

retractions Drawing in of the intercostal muscles and sternum during inspiration; a sign of increased work of breathing.

septum The central divider in the nose.

sniffing position Optimum neutral head position for the uninjured child who requires airway management.

stridor A high-pitched breath sound heard mainly on inspiration that is a sign of upper airway obstruction.

tachypnea Increased respiratory rate.

tenting A condition in which the skin remains depressed after you remove your finger; indicates dehydration.

Prep Kit continued...

tidal volume The amount of air that is delivered to the lungs and airways in one inhalation.

tragus The small cartilaginous projection in front of the opening of the ear.

transition phase A time period that allows the infant or child to become familiar with you and your equipment; only appropriate if the child's condition is stable.

tripod position An abnormal position to keep the airway open; it involves leaning forward onto two arms stretched forward.

wheezing A whistling breath sound caused by air traveling through narrowed air passages within the bronchioles; a sign of lower airway obstruction.

work of breathing An indicator of oxygenation and ventilation. Work of breathing reflects the child's attempt to compensate for hypoxia.

xiphoid process The lower tip of the sternum.

Points to Ponder

You are dispatched to 722 Chase St for a child with asthma. You arrive to find a 12-year-old girl who is obviously experiencing difficulty breathing. You hear audible wheezing and notice accessory muscle use. Her respiratory rate is 60 breaths/min. She tells you (in 1- to 2-word phrases) that she used her inhaler before you arrived, but it does not seem to be working as well as it usually does. She also tells you that she has been sick recently.

You apply high-flow oxygen and begin transporting her to the nearest hospital. As you obtain your second set of vital signs, you notice her wheezing is gone and her respiratory rate has slowed significantly, but she seems to be staring off into space. You try to get her attention, but she doesn't seem to notice you.

Why is her speaking ability significant? What factors point to the deterioration of her condition?

Issues: Importance of Immediate Transport for Critical Pediatric Patients, Importance of Ongoing Assessments.

Assessment in Action

You are off duty and are at the home of a close friend who has several children. You and your friend are enjoying a cup of coffee in the kitchen while some of the older, teenaged children play a board game in the next room. The family's 7-month-old infant, who can now crawl very easily, is also in the room with the other children. Suddenly you hear one of the teenagers scream, "Mom! Something's wrong with the baby!" You both rush into the living room to find the infant turning blue.

1. What is the first thing should you do?
   - **A.** Ask about the infant's medical history.
   - **B.** Check responsiveness.
   - **C.** Visualize the airway.
   - **D.** Provide back blows.
2. What do you suspect was the cause of the problem?
   - **A.** Seizure
   - **B.** Cardiac arrest
   - **C.** Foreign body airway obstruction
   - **D.** Asthma
3. What would be appropriate care for a 7-year-old in this situation?
   - **A.** Back blows
   - **B.** Chest thrusts
   - **C.** Blind finger sweep
   - **D.** Heimlich maneuver
4. The baby now seems fine. You should:
   - **A.** watch the baby for 1 hour.
   - **B.** put the baby down for a nap.
   - **C.** take the baby to the emergency department.
   - **D.** feed the baby.
5. The pediatric assessment triangle includes:
   - **A.** appearance.
   - **B.** work of breathing.
   - **C.** skin signs.
   - **D.** all of the above.
6. High-pitched inspiratory sounds are called:
   - **A.** wheezing.
   - **B.** grunting.
   - **C.** stridor.
   - **D.** none of the above.

Challenging Questions

7. Why is it important to use appropriate airway adjuncts for the pediatric patient?
8. How is the AVPU scale modified for use in children?
9. What is the significance of bradypnea in a child who has been previously exhibiting signs of increased work of breathing?
10. How do physical exams differ in young children than adults?