Emily gets sick so much faster than my other children. I guess the bronchopulmonary dysplasia and her tracheostomy make her more susceptible to infections. I really get concerned because she struggles so hard to breathe when she gets all these extra secretions. I have learned to suction and change her tracheostomy, but I am afraid that one day she will completely obstruct her airway. I just hope I remember all the things I have been taught if that happens, and that the emergency medical personnel come quickly.

—Father of Emily, 8 months

LEARNING OBJECTIVES

- Describe unique characteristics of the pediatric respiratory system anatomy and physiology and apply that information to the care of children with respiratory conditions.
- List the different respiratory conditions and injuries that can cause respiratory distress in infants and children.
- Assess the child’s respiratory signs and symptoms to distinguish between respiratory distress and respiratory failure and describe the appropriate nursing care.
- Develop a nursing care plan for a child with common acute respiratory conditions.
- Develop a nursing care plan for the child with a chronic respiratory condition.

MEDIA LINK

CD-ROM
- Animations
  - CO₂ and O₂ Transport
  - Gas Exchange
- Videos
  - Pediatric Respiratory Emergency Management
  - SIDS
- Skill 11-12: Using a Metered Dose Inhaler
- Skill 14-2: Oxygen Saturation: Pulse Oximetry
- Skill 14-5: Peak Expiratory Flow Meter
- Skill 14-11: Tracheostomy Care
- Skill 14-25: Performing Chest Physiotherapy/Postural Drainage
- NCLEX-RN® Review
- Audio Glossary

Companion Website
- Thinking Critically
- MediaLink Applications
- Teaching Plan: Metered Dose Inhaler
- Teaching Plan: Discharge Instructions for a Child with a Tracheostomy Tube
- Nursing Care Plan: The Child with Cystic Fibrosis
- NCLEX-RN® Review
- Audio Glossary
This chapter explores several special factors in the child’s respiratory system that create ongoing threats to respiratory function and overall health. Most respiratory problems in children produce mild symptoms, last a short time, and can be managed at home. Nevertheless, acute respiratory problems are the most common cause of illness requiring hospitalization in infants and children under 10 years of age and a leading cause of hospitalization in children between 10 and 15 years of age (Health Resources and Services Administration, 2002).

Pediatric respiratory conditions may occur as a primary problem or as a complication of nonrespiratory conditions and may be life threatening or have long-term implications. Nurses must learn to assess the child’s current respiratory status quickly, monitor progress, and anticipate potential complications (Table 47–1).

Respiratory problems may result from structural problems, functional problems, or a combination of both. Structural problems involve alterations in the size and shape of parts of the respiratory tract. Functional problems involve

### KEY TERMS

- Adventitious, 1389
- Airway remodeling, 1415
- Airway resistance, 1390
- Alveolar hypoventilation, 1394
- Apnea, 1396
- Cor pulmonale, 1397
- Dysphagia, 1403
- Dysphonia, 1403
- Dyspnea, 1392
- Hypercapnia, 1394
- Hypoxemia, 1394
- Hypoxia, 1394
- Laryngospasm, 1401
- Paradoxical breathing, 1389
- Periodic breathing, 1396
- Polysomnography, 1397
- Retractions, 1391
- Stridor, 1400
- Tachypnea, 1389
- Trigger, 1414

### TABLE 47–1  Assessment Guidelines for a Child in Respiratory Distress

<table>
<thead>
<tr>
<th>Quality of Respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Inspect the rate, depth, and ease of respirations. See Table 35–8 for expected respiratory rate ranges by age.</td>
</tr>
<tr>
<td>■ Identify the signs of respiratory distress: tachypnea (abnormally rapid rate of respirations), retractions, nasal flaring, inspiratory stridor, expiratory grunting.</td>
</tr>
<tr>
<td>■ Note lack of simultaneous chest and abdominal rise with inspiration (paradoxical breathing).</td>
</tr>
<tr>
<td>■ Auscultate breath sounds to see if they are bilateral, diminished, or absent, and for presence of adventitious sounds (wheezes, crackles, rhonchi).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality of Pulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Assess the rate and rhythm: tachycardia may indicate hypoxia.</td>
</tr>
<tr>
<td>■ Compare pulse sites (apical to brachial) for strength and rate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Observe overall color: with respiratory distress, color progresses from pallor to mottled to cyanosis; central cyanosis is a late sign of respiratory distress.</td>
</tr>
<tr>
<td>■ Compare peripheral and central color: assess capillary refill and nailbed color and inspect mucous membranes; central cyanosis in mucous membranes is more ominous.</td>
</tr>
<tr>
<td>■ Note whether crying improves or worsens color.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cough</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Quality: note whether it is dry (nonproductive), wet (productive, mucousy), brassy (noisy, musical), or croupy (barking, seal-like).</td>
</tr>
<tr>
<td>■ Effort: note whether it is forceful or weak; weak cough may indicate an airway obstruction or fatigue from prolonged respiratory effort (not valid in newborns).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behavior Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Note level of consciousness: alert or lethargic; lethargy may indicate hypoxia.</td>
</tr>
<tr>
<td>■ Restlessness and irritability are associated with hypoxia.</td>
</tr>
<tr>
<td>■ Watch for abrupt behavior changes; restlessness, irritability, and lowered level of consciousness may indicate increasing hypoxia.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of Dehydration</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Inspect for dry mucous membranes, lack of tears, poor skin turgor, and decreased urine output, which indicate that fluid needs are not being met.</td>
</tr>
</tbody>
</table>

*Refer to Chapter 35 for the actual techniques of assessment mentioned in this table.  

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alterations in gas exchange and threats to this normal process from irritants (such as large particles and chemicals) or invaders (such as viruses or bacteria). Alterations in other organ systems, especially the immune and neurologic systems, may also threaten respiratory function. When reading this chapter, keep the distinction between structural and functional problems in mind to help distinguish between what is normal and what is abnormal about the child's maturing respiratory system. See Chapter 46 for upper respiratory conditions such as colds, otitis, sinusitis, and pharyngitis.

ANATOMY AND PHYSIOLOGY OF PEDIATRIC DIFFERENCES

The child’s respiratory tract constantly grows and changes until about 12 years of age. The young child’s neck is shorter than an adult’s, resulting in airway structures that are closer together.

UPPER AIRWAY DIFFERENCES

The child’s airway is shorter and narrower than an adult’s. These differences create a greater potential for obstruction (see “As Children Grow: Airway Development”). The infant’s airway is approximately 4 mm in diameter, about the width of a drinking straw, in contrast to the adult’s airway diameter of 20 mm. The trachea primarily increases in length rather than diameter during the first 5 years of life. The child’s little finger is a good estimate for the child’s tracheal diameter and can be used for a quick assessment of airway size. The trachea in a child is higher and at a different angle than the adult’s (see “As Children Grow: Trachea Position”). The child’s narrower airway causes an increase in airway resistance, the effort or force needed to move

It is easy to see that a child’s airway is smaller and less developed than an adult’s airway, but why is this important? An upper respiratory tract infection, allergic reaction, positioning of the head and neck during sleep, and the small objects children play with can have serious consequences in the child.
At birth the lung tissue contains only 25 million alveoli, which are not fully developed. The number of alveoli increases to 300 million by 8 years of age, after which these structures begin increasing in size and complexity until puberty (Froh, 2002).

Physiologically, the upper airway is the port for inspiration of oxygen and expiration of carbon dioxide. Infants, children, and adults can breathe through either the nose or the mouth. Until 4 weeks of age, newborns are obligatory nose breathers. The coordination of mouth breathing is controlled by maturing neurologic pathways; thus, young infants do not automatically open the mouth to breathe when the nose is obstructed. The only time a newborn breathes through the mouth is when he or she is crying. Nasal patency in newborns is therefore essential for such activities as breathing and eating.

**Lower Airway Differences**

The developing alveoli change size and shape, and their numbers increase until respiratory maturity is attained at puberty (Froh, 2002). Alveolar growth increases the area available for gas exchange. At birth the distal (peripheral) bronchioles that extend to the alveoli are narrow and fewer in number than in an adult. The child’s overall growth can be correlated to the increased branching of the peripheral bronchioles as the alveoli continue to multiply. The taller the child, the greater the lung surface area.

The bronchi and bronchioles are lined with smooth muscle. The newborn does not have enough smooth muscle bundles to help trap airway invaders. By 5 months of age, however, a baby has enough muscles to react to irritants by bronchospasm and muscle contraction. Smooth muscle development is complete and comparable to that of an adult by 1 year of age (Webster & Huether, 1998).

Ventilation is the movement of air in and out of the lungs and alveoli. The lungs rely on the diaphragm and intercostal muscles to power respiration. Children under 6 years of age use the diaphragm to breathe as the intercostal muscles are immature. The negative pressure caused by the downward movement of the diaphragm draws in air. By 6 years of age, the child uses the intercostal muscles more effectively. The ribs are primarily cartilage and very flexible, and in cases of respiratory distress, the negative pressure caused by the diaphragm movement causes the chest wall to be drawn inward, causing retractions (see “Pathophysiology Illustrated: Retraction Sites”).
CHAPTER 47

RESPIRATORY DISTRESS AND RESPIRATORY FAILURE

Many respiratory conditions associated with difficulty breathing can progress to respiratory distress. If the condition is not managed effectively, it can progress to respiratory failure. Foreign-body aspiration is a common cause of airway obstruction and respiratory distress.

FOREIGN-BODY ASPIRATION

Foreign-body aspiration is the inhalation of any object (solid or liquid, food or nonfood) into the respiratory tract. Aspiration occurs most often during feeding and reaching activities, while crawling, or during playtime in children 6 months to 4 years of age. These young children have a tendency to put small objects in the mouth. However, aspiration may occur in children of any age.

Etiology and Pathophysiology

In infants over 6 months of age and young children, any number of small objects that make their way into the child’s mouth may cause aspiration. Foods such as nuts, popcorn, or small pieces of raw vegetables or hot dog; small, loose toy parts such as small wheels and bells; or household objects and substances such as beads, safety pins, coins, buttons, latex balloon pieces, and colorful liquids (mouthwash, perfume) in enticing packages (screw-top bottles) are frequent causes of airway obstruction. Partial and sometimes complete airway obstruction can occur.

The severity of the obstruction depends on the size and composition of the object or substance and its location within the respiratory tract. Most aspirated foreign bodies (AFBs) usually cause bronchial, not tracheal, obstruction. An object lodged high in the airway above the vocal cords is frequently coughed out.

The right lung is the most common site of lower airway aspiration because of the sloped angle of its bronchus (see “As Children Grow: Trachea Position” on page 1391). Objects may migrate from higher to lower airway locations. An object may also move back up to the trachea, creating extreme respiratory difficulty. If oxygen is depleted for an extended time, brain damage may occur.

Clinical Manifestations

Children are usually brought to the hospital after a sudden episode of coughing or gagging. The child may have signs of increased respiratory effort such as dyspnea (difficulty breathing), tachypnea (rapid respiratory rate), nasal flaring, and retractions. If the child cannot say the “P” in words like Pluto or Peter Pan, the foreign body has noticeably diminished expiratory effort. As respiratory distress progresses, the child may have a concentrated focus on breathing, have an anxious expression, and sit in a forward position with the neck extended. As the child becomes increasingly hypoxic, behavior changes such as irritability and decreased responsiveness are seen.

Coughing, choking, gagging, dysphonia, and wheezing may be brief or may persist for several hours if the object drops below the trachea into one of the mainstem bronchi. In some cases the child may become asymptomatic after coughing for 15 to 30 minutes. If the foreign body drops into the lower airway and is not removed, the child may present with a chronic cough, persistent or recurrent pneumonia, or a lung abscess weeks later.

Clinical Therapy

Clinical therapy focuses on taking a careful history to determine whether aspiration has indeed occurred. Coughing, gagging, or choking associated with feeding or crawling on the floor is usually a confirming event for aspiration. The physical examination often reveals decreased breath sounds, stridor, and respiratory distress in the child without a witnessed aspiration. A special radiograph, called a forced expiratory film, may be ordered. This shows local hyperinflation (air trapping) and a mediastinal shift away from the affected side (Hazinski, 1999). Sometimes, when the object aspirated is radiopaque, it
Fluoroscopy and fiberoptic bronchoscopy may be used to identify, locate, and extract the AFB. See the section on pneumonia, page 1409, for care of the child with complications of aspiration.

**NURSING MANAGEMENT**

**NURSING ASSESSMENT AND DIAGNOSIS**

**Physiologic Assessment**
The child will be in respiratory distress, and constant monitoring is essential. Perform the respiratory assessment following guidelines in Table 47–1. If the object remains lodged, observe the child for increasing signs of respiratory distress, especially vital signs, audible wheezing on auscultation, and retractions. Note changes in breath sounds, from noisy to decreasing to absent, on the affected side. This can indicate that the object is moving and blocking a mainstem bronchus. Attach the child to a cardiorespiratory monitor and pulse oximeter to assess the child for subtle signs of increasing hypoxia.

**Psychosocial Assessment**
The unexpected and acute nature of the event creates anxiety for both parents and child. The child will be fearful because of difficulty breathing. Assess coping and level of stress.
As the child’s condition stabilizes, observe how well the child’s abilities match the parents’ understanding of age-appropriate behaviors. See developmental abilities by age Chapter 33.

Common nursing diagnoses for a child with an AFB include the following:

- **Ineffective Airway Clearance** related to foreign body aspiration
- **Impaired Spontaneous Ventilations** related to foreign body aspiration and respiratory muscle fatigue
- **Fear (Parent or Child)** related to uncertainty of prognosis, unfamiliar surroundings and procedures
- **Risk for Injury** related to developmental age and small objects in environment

**PLANNING AND IMPLEMENTATION**

The period right after aspiration until AFB removal is critical. Promptly document and report any subtle changes in the child’s respiratory status. The nurse must remain with the child who has a significant obstruction, and have resuscitation equipment at the bedside. Permit the child to stay in a position of comfort. Avoid performing procedures that increase the child’s anxiety as sudden movements and increased respiratory efforts may cause the obstruction to move and completely obstruct the airway. Be prepared to perform back blows and chest thrusts for an infant or abdominal thrusts for the child with complete obstruction. (See Skill 14–9. )

After the AFB is removed, the child is stabilized and observed for a few hours in a short-stay unit.

**Discharge Planning and Home Care Teaching**

Discharge planning centers on anticipatory guidance about childproofing the home (see Chapter 33). Encourage the parents to learn CPR, choking-prevention techniques, and back blows, chest thrusts, or abdominal thrusts.

**EVALUATION**

Expected outcomes of nursing care include the following:

- The child regains the ability to ventilate spontaneously after removal of the foreign body.
- Parents complete a safety check of the home to prevent future aspiration incidents.

**RESPIRATORY FAILURE**

Respiratory failure occurs when the body can no longer maintain effective gas exchange. The physiologic process that ends in respiratory failure begins with hypoventilation of the alveoli. Hypoventilation occurs when the body’s need for oxygen exceeds actual oxygen intake, the airway is partially occluded, or the transfer of oxygen and carbon dioxide in the alveoli is disrupted. This disruption may occur either because of a malfunction of respiratory center stimulation (the alveoli do not receive the message to diffuse) or because the alveolar membrane is defective (a structural problem).

**Alveolar hypoventilation** (poor ventilation of the alveoli) results in **hypoxemia** (lower than normal blood oxygen level) and **hypercapnia** (an excess of carbon dioxide in the blood). Arterial blood gas levels indicative of respiratory failure are a **PaO₂ level less than 50 mm Hg** and a **PaCO₂ level greater than 50 mm Hg** in a patient breathing room air (Grant & Curley, 2001). See Appendix B for expected laboratory values by age and Skill 10–6. When the blood levels of oxygen and carbon dioxide reach abnormal levels, **hypoxia** (lower than normal oxygen in the tissues) occurs and respiratory failure begins. Hypoxemia that persists when supplemental oxygen is given is a sign of respiratory failure.

Signs of impending respiratory failure include irritability, lethargy, cyanosis, and increased respiratory effort such as dyspnea, tachypnea, nasal flaring, and intercostal retractions. Grunting slows the expiratory flow and increases the lung volume and alveolar pressures. This is a sign of severe disease and suggests the onset of respiratory failure (Margolis & Gadomski, 1998).

**Nursing Management**

Early recognition of impending respiratory failure is the most important aspect of care for a child with any signs of respiratory compromise. When the child has a chronic respiratory condition, development of respiratory failure may be gradual. Signs will be subtle. Be particularly alert to behavior changes in addition to respiratory signs. Serial blood gases may be needed to monitor the child.

Place a child who has respiratory distress in an upright position (by elevating the head of the bed). Assess respiratory quality and rate, followed by apical pulse rate and temperature. Monitor oxygen saturation with pulse oximetry. Administer oxygen as ordered and keep respiratory emergency equipment at the child’s bedside. Monitor the child for changes in vital signs, respiratory status, and level of responsiveness. Be prepared to assist ventilations if respiratory status deteriorates. (See Skills 9–8 to 9–10. )
The Child with Alterations in Respiratory Function

CLINICAL MANIFESTATIONS

RESPIRATORY FAILURE AND IMMINENT RESPIRATORY ARREST

<table>
<thead>
<tr>
<th>PHYSIOLOGIC CAUSE</th>
<th>CLINICAL MANIFESTATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory failure</td>
<td>Initial signs&lt;br&gt;Restlessness&lt;br&gt;Tachypnea&lt;br&gt;Tachycardia&lt;br&gt;Diaphoresis</td>
</tr>
<tr>
<td>The child tries to use accessory muscles to assist oxygen intake; hypoxia persists and efforts now waste more oxygen than is obtained.</td>
<td>Early decompensation&lt;br&gt;Nasal flaring&lt;br&gt;Retractions&lt;br&gt;Grunting&lt;br&gt;Wheezing&lt;br&gt;Anxiety and irritability&lt;br&gt;Mood changes&lt;br&gt;Headache&lt;br&gt;Hypertension&lt;br&gt;Confusion</td>
</tr>
<tr>
<td>Imminent respiratory arrest</td>
<td>Severe hypoxia&lt;br&gt;Dyspnea&lt;br&gt;Bradycardia&lt;br&gt;Cyanosis&lt;br&gt;Stupor and coma</td>
</tr>
</tbody>
</table>

Excessive crying and anxiety deplete metabolic reserves. External ventilatory support and vigorous crying may impede diaphragm function if the stomach becomes distended with air. Because the child’s metabolic rate is about double that of an adult, the child has a greater need for oxygen. Respiratory distress, anxiety, and even fever can dramatically add to the child’s oxygen demand.

Using Artificial Airways

Respiratory problems that do not respond to oxygen therapy, medications, or position changes require the insertion of an artificial airway. As the child’s level of responsiveness deteriorates, the ability to keep the airway open decreases. Endotracheal intubation is a short-term, emergency measure to stabilize the airway by placing a tube in the trachea. The tube must be protected and stabilized to prevent its displacement. (See Skills 14–8 and 14–9.) A tracheostomy is the creation of a surgical opening into the trachea through the anterior neck at the cricoid cartilage. Surgeons prefer to perform this procedure in the operating room; however, a tracheostomy may also be performed in an emergency department or other setting when immediate intervention is needed. These children usually require admission to the intensive care unit (ICU) for monitoring and ventilatory support. Suction airway secretions as needed and provide tracheostomy care if present. See Skills 14–20—14–24 in the Clinical Skills Manual.

Because endotracheal and tracheostomy tubes prevent vocal cord vibration, intubated children cannot cry or talk. Infants and young children often express initial frustration when they realize they cannot communicate verbally. When the child is alert, give suggestions for ways to make noise and gain attention, such as striking the mattress. A communication board can be used with older children.

Many children are discharged from the hospital and cared for at home for an extended period with a tracheostomy tube in place. It is essential to teach parents how

THINKING CRITICALLY

OXYGEN DELIVERY DEVICES

Oxygen delivery devices are selected to match the concentration of oxygen needed by the child. In respiratory failure, a higher concentration of oxygen is needed to reverse the hypoxemia. Which oxygen delivery device should be used? Are there any contraindications to oxygen use in a child who is hypoxic?
to maintain the airway, clean the tracheostomy site, and change the tube. A home healthcare nurse can provide follow-up care and support for the child and family. (See Skill 14–11.)

APNEA

Infants have periodic breathing, an irregular rhythm, and may have pauses of up to 20 seconds between breaths. This breathing pattern is not apnea. Apnea is the cessation of respiration lasting longer than 20 seconds, or any pause in respiration associated with cyanosis, marked pallor, hypotonia, or bradycardia. Apnea may be the first major sign of respiratory dysfunction in the newborn (see respiratory distress in Chapter 30).

APPARENT LIFE-THREATENING EVENT (ALTE)

Apparent life-threatening event (ALTE) is defined as an episode of apnea accompanied by a color change (cyanosis, pallor, or occasionally, redness), limp muscle tone, choking, or gagging in a near-term or term infant who is greater than 37 weeks’ gestation. The majority of these events occur in infants under 4 months of age, with a peak incidence between 1 week and 2 months (Davies & Gupta, 2002). These episodes may occur during sleep, wakefulness, or

### CLINICAL MANIFESTATIONS

#### CAUSES OF APPARENT LIFE-THREATENING EVENTS

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>CLINICAL MANIFESTATIONS</th>
<th>DIAGNOSTIC TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional or structural airway problem or immaturity</td>
<td>Apnea of 20 sec or longer; accompanied by bradycardia or cyanosis</td>
<td>Cardiorespiratory monitoring, sleep study, pneumogram, sepsis workup</td>
</tr>
<tr>
<td>Aspiration as a result of dysfunctional swallowing or gastroesophageal reflex</td>
<td>Choking, coughing, cyanosis, vomiting</td>
<td>Barium swallow, esophageal pH probe</td>
</tr>
<tr>
<td>Cardiac problems</td>
<td>Tachycardia, tachypnea, dyspnea</td>
<td>Cardiorespiratory monitoring, electrocardiogram, echocardiogram, arterial blood gases</td>
</tr>
<tr>
<td>Drug toxicity or poisoning; maternal history of ingestion</td>
<td>Central nervous system depression, hypotonia</td>
<td>Serum magnesium level, toxicity screen</td>
</tr>
<tr>
<td>Environmental, thermoregulation problem</td>
<td>Lethargy, tachycardia, hypothermia or hyperthermia</td>
<td>Cardiorespiratory and temperature monitoring, environmental temperature level (ambient air temperature)</td>
</tr>
<tr>
<td>Impaired oxygenation, respiratory disease (pulmonary edema, atelectasis, pneumonia)</td>
<td>Cyanosis, tachycardia, respiratory distress, anemia, choking, coughing</td>
<td>Oximetry, chest radiograph, arterial blood gases, complete blood count, upper airway evaluation, sleep study, serum electrolytes</td>
</tr>
<tr>
<td>Acute infection (sepsis, meningitis, necrotizing enterocolitis)</td>
<td>Feeding intolerance, lethargy, temperature instability</td>
<td>Complete blood count, cultures when appropriate, C-reactive protein, chest and abdominal radiographs</td>
</tr>
<tr>
<td>Intracranial pathology (intraventricular hemorrhage, ventricular dilation, central nervous system anomalies, meningitis)</td>
<td>Abnormal neurologic examination, seizures</td>
<td>Cranial ultrasound, computed tomography scan, electroencephalogram, magnetic resonance imaging, cerebrospinal fluid evaluation</td>
</tr>
<tr>
<td>Metabolic disorders</td>
<td>Jitteriness, poor feeding, lethargy, central nervous system depression or irritability, hypotonia</td>
<td>Serum electrolytes (potassium, sodium, chloride), glucose, calcium, arterial blood gases</td>
</tr>
</tbody>
</table>

feeding. ALTE should not be confused with sudden infant death syndrome (SIDS) (see page 1398).

A variety of identifiable diseases and conditions can cause ALTE, such as infection, gastroesophageal reflux, seizures, cardiac arrhythmias, and metabolic or endocrine problems. In some cases, no cause is identified. ALTE can frighten the parent or observer, who often fears the infant has died. Emergency resuscitation is usually required.

**Nursing Management**

After ALTE, infants are usually admitted to the hospital for evaluation and cardiorespiratory monitoring. Nursing care includes collecting a detailed history of the event, observing and monitoring cardiorespiratory status, providing supportive care to the infant and family, and anticipating the need for emergency resuscitation and for the diagnostic process.

**Monitor Cardiorespiratory Status.** Cardiorespiratory monitoring records heart rate and respiratory rate while the infant is awake and asleep. Pulse oximetry provides a noninvasive continuous evaluation of the infant's oxygenation status. A pulse oximetry reading (SpO2) less than 95% indicates hypoxemia. (See Skills 14–2 to 14–4. )

**Provide Emotional Support.** Establishing rapport and open communication with the parents is essential for creating a sense of trust. To obtain further information about the episode, use open-ended questions and active listening skills. Parents are fearful and anxious about the infant's prognosis. Explanations of tests and treatment help to decrease their anxiety and increase their understanding of the situation.

During hospitalization the infant should be held and cuddled to provide a sense of security and well-being. Encouraging parents' participation in the infant's care helps to meet these needs and promotes family bonding. Often parents are afraid to touch the infant because they might disconnect the monitoring cable. Wrapping the cable inside the infant's blanket helps secure the wires, increasing parents' feelings of confidence in handling the infant.

Support the mother to continue breastfeeding and maintaining a supply of breast milk by pumping, if necessary. Ensure that the mother gets adequate fluids and nutrition. Provide privacy for breast pumping, and store breast milk for future feedings.

**Anticipate Emergency Resuscitation.** Because the infant who has had ALTE continues to be at risk for cardiopulmonary arrest, keep emergency resuscitation equipment and drugs readily accessible at all times.

**Discharge Planning and Home Care Teaching.** Identify and address home care needs well in advance of discharge. Teach parents how to operate an apnea monitor, what to do when the infant has an apneic episode, and how to perform cardiopulmonary resuscitation (CPR) and choking-prevention techniques (see Skill 14–13).

---

**OBSTRUCTIVE SLEEP APNEA**

Obstructive sleep apnea syndrome (OSA) is a disorder of breathing during sleep that involves prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal ventilation during sleep and normal sleep patterns (American Academy of Pediatrics, 2002). This results in labored breathing and snoring when the child tries to move air past the obstruction. Its incidence peaks between 2 and 6 years of age when tonsils and adenoids are at their largest in contrast to the airway's size.

The upper airway contains about 30 muscles that permit the pharynx to collapse, enabling the child to talk and swallow, but also maintain airway patency. When the child is awake, muscle tone is maintained and the airway remains patent even when obstructions such as enlarged adenoids and tonsils, craniofacial anomalies, or obesity are present. During sleep, the airway muscles relax and the pharynx becomes obstructed. When the airway muscles are relaxed, the airway resistance is increased. Reduced upper airway tone and obstruction then results in apnea episodes that lead to hypoventilation, hypoxia, hypercapnia, and an elevated blood pressure. Hypertrophy of the adenoids and tonsils is the most common cause of OSA, followed by craniofacial abnormalities. Without treatment, complications develop that can include failure to thrive, pulmonary hypertension, cor pulmonale, obstructive sleep apnea syndrome, systemic hypertension, and cognitive impairment.

Children with OSA snore and have signs of labored breathing during sleep such as retractions and paradoxical breathing. After pauses in snoring or lack of airflow, the child may be noted to snort, gasp, choke, move, or arouse to take a breath. Sleep is restless and the child may sleep in unusual positions to hyperextend the neck and airway. Daytime sleepiness and other symptoms of sleep deprivation (poor attention, increased activity, aggression, acting-out behavior, poor school performance) may be noted.

Diagnosis is made by polysomnography, a sleep study that simultaneously records the brain activity, eye movement, apnea episodes, oxygen desaturation and sleep disturbances. Adenotonsillectomy is the most common treatment for OSA, and resolution of the condition occurs in the majority of children. Weight loss strategies may be implemented for obese children. Continuous positive airway pressure (CPAP) is used for children with surgical contraindications or those with persistent OSA.

**Nursing Management**

In the community setting, all children should be screened for snoring as part of their routine healthcare. Assess the child for signs of nasal obstruction, mouth breathing, and enlarged tonsils. Determine if the child has symptoms of...
sleep deprivation or if a condition is present that places the child at high risk for OSA. Coordinate referral to a sleep center for polysomnogram evaluation and explain the purpose of the test. Discuss how to prepare the child for the strange setting and wires that will be attached during the sleep study. Most pediatric centers will allow the parent to stay with the child during the study.

Following adenotonsillectomy, the hospital nurse monitors the child for bleeding and respiratory distress, such as obstructive sleep apnea and pulmonary edema. Continuous pulse oximetry is used to detect oxygen desaturation. See Chapter 46 for care of the child having adenotonsillectomy.

Sleep center nurses provide education and support to families of children who need to use CPAP to treat the OSA. The nurse helps identify the best fitting mask or nasal prong system for CPAP delivery. Parents may need guidance about helping children to go to sleep wearing the mask until they are accustomed to it.

SUDDEN INFANT DEATH SYNDROME (SIDS)

Sudden infant death syndrome (SIDS) has been defined as the sudden unexpected death of an infant under 1 year of age with onset of the fatal episode during sleep that remains unexplained after a thorough investigation, including an autopsy, a review of the circumstances of death, and a review of the clinical history (Krous, 2004). It remains a leading cause of death in infants between 1 month and 1 year of age, with 90% of cases occurring before 6 months of age (American Academy of Pediatrics Committee on Child Abuse and Neglect, 2001). SIDS occurs rarely in infants younger than 2 weeks. It is currently unpredictable and in some cases unpreventable.

SIDS is referred to as a “syndrome” because of the many and varied autopsy and clinical findings that characterize most infants who die of the disorder. The autopsy typically does not identify a disease process that caused the death. Current evidence suggests a genetic susceptibility to SIDS (American Academy of Pediatrics Committee...
on Fetus and Newborn, 2003). The current thinking is that vulnerable infants have a defect in the arcuate nucleus, a brain structure that plays a role in regulating breathing, heartbeat, body temperature, and arousal (Kato, Franco, Grosasser et al., 2003; Parnigrasy, Filiano, Sleeper et al., 2000). Child abuse and homicide may be associated with 1% to 5% of suspected SIDS cases (American Academy of Pediatrics Committee on Child Abuse and Neglect, 2001). Other proposed causes include H. pylori gastrointestinal infection and long QT syndrome, a cardiac arrhythmia. (See cardiac arrhythmias in Chapter 48. SIDS has not been found to be associated with newborn apnea or immunizations for diphtheria, tetanus, and pertussis (DTaP). See Table 47–2 for infant and maternal factors that place infants at risk for SIDS.

The first symptom is a cardiac arrest. Clinical findings include evidence of a struggle or change in position during sleep and the presence of frothy, blood-tinged secretions from the mouth and nares. Typically parents find the infant dead in the crib in the morning or after a nap and report having heard no cries or disturbances during the night.

**Nursing Management**

The sudden, unexpected nature of the infant’s death is confirmed in the emergency department. The nurse’s role is to be empathetic and provide support during one of the greatest crises a family must face. The focus is on supporting the family during the acute grieving period. See Table 47–3.

**TABLE 47–2**  
**Risk Factors for Sudden Infant Death Syndrome (SIDS)**

<table>
<thead>
<tr>
<th>Infant</th>
<th>Maternal Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race (in decreasing order of frequency): most common in Native American infants, followed by black, Hispanic, white, and Asian infants.</td>
<td>Maternal age less than 20 years at first pregnancy and a short interval between pregnancies.</td>
</tr>
<tr>
<td>Gender: more common in males than females</td>
<td>Prenatal smoking, binge alcohol, and illicit drug use.</td>
</tr>
<tr>
<td>Age: most common in infants between 2 and 4 months of age</td>
<td>Anemia.</td>
</tr>
<tr>
<td>Time of year: more prevalent in winter months</td>
<td>Poor prenatal care, low weight gain during pregnancy.</td>
</tr>
<tr>
<td>Exposure to passive smoke</td>
<td>History of sexually transmitted disease or urinary tract infection.</td>
</tr>
<tr>
<td>Sleeping arrangement: prone or side-lying position and turning to prone, sharing bed with others, use of pillows and quilts with bedding</td>
<td></td>
</tr>
<tr>
<td>Overheating due to excessive blankets, clothing on infant, room temperature</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 47–3**  
**Supportive Care for the Family of an Infant with Sudden Infant Death Syndrome (SIDS)**

1. Provide parents with a private area and a support person who reinforces that the infant’s death was not their fault. Parents need to be able to express their grief in their own way and hear that they are not being blamed for the infant’s death.

2. Prepare the family for the viewing of the infant. Describe how the infant will look and feel. You can say, “Paul’s [use the infant’s name] skin will feel cool. He will be very still and his eyes will be closed.” They probably know this, but a gentle explanation demonstrates empathy. Explain that pooling of blood on the dependent areas will look like bruises.

3. Allow parents to hold, touch, and rock the infant if desired. Before bringing the infant to parents, wrap in a clean blanket, comb the hair, wash the face, swab the mouth clean, and apply Vaseline to lips.

4. Reinforce the physician’s explanation about the need for an autopsy. An autopsy is required for all unexplained deaths. You can say to parents, “It is the only way we can be sure of what caused your baby’s death.”

5. Answer parents’ questions and provide them with sources for further information. Provide literature and a name of the local contact for a SIDS support group, as well as for the national foundation. Parents may not be able to take in all of your answers. Many emergency departments and pediatric units have a social worker who provides ongoing contact with the family. Provide names of resource people and phone numbers for SIDS support groups.

6. Advise parents that surviving siblings may benefit from psychologic support. Siblings often require emotional support in the weeks and months after the death. Social workers can help the family obtain counseling and support for all members.

7. Provide parents with a lock of hair, footprints, and handprints, if they desire. Personal items can be placed in a memory book. This reaffirms the child’s existence for many parents.

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**NURSING PRACTICE**

Guidelines for the support of families experiencing SIDS should include baptism services, religious support, grief counseling, assistance with funeral arrangements, and counseling on cessation of breastfeeding and sibling reactions.

Reassure the parents that they are not responsible for the infant’s death and help them contact other family members and mobilize support. Older children may need reassurance that SIDS will not happen to them. They may also believe that bad thoughts or wishes about their baby...
CHAPTER 47

CROUP SYNDROMES

Croup is a term applied to a broad classification of upper airway illnesses that result from swelling of the epiglottis and larynx. The swelling usually extends into the trachea and bronchi. Included under the classification of croup syndromes are viral syndromes, such as spasmodic laryngitis (spasmodic croup), laryngotracheitis, and laryngotracheobronchitis (LTB), and bacterial syndromes, such as bacterial tracheitis and epiglottitis (see “Pathophysiology Illustrated: Airway Changes with Croup”).

LTB, epiglottitis, and bacterial tracheitis are referred to as the “big three” of pediatric respiratory illness because they affect the greatest number of children across all age groups in both sexes. The initial symptoms of all three conditions include inspiratory stridor (a high-pitched, musical sound that is created by narrowing of the airway), a “seal-like” barking cough, and hoarseness. LTB is the most common disorder, but epiglottitis and bacterial tracheitis are more serious.

LARYNGOTRACHEOBRONCHITIS

Although the term croup is applied to several viral and bacterial syndromes, it is most often used to refer to LTB, a viral invasion of the upper airway that extends throughout the larynx, trachea, and bronchi. Table 47–4 compares LTB and other croup syndromes.

Etiology and Pathophysiology

Acute viral LTB is most common in children 3 months to 4 years of age but can occur up to 8 years of age. Boys are affected more often than girls. LTB is of greatest concern in infants and children under the age of 6 years, because of potential airway obstruction. The causative organism is usually parainfluenza virus type I, II, or III, that appears during winter months. Other viruses causing LTB include influenza A and B, adenovirus, respiratory syncytial virus, and measles (Perkin & Swift, 2002).

Airway tissues respond to the invading virus with inflammation and edema. Copious, tenacious secretions further increase the child’s respiratory distress. The laryngeal inflammation causes the airway diameter to narrow in the subglottic area, the narrowest part of the airway. Even small amounts of mucus or edema can quickly obstruct the airway. Both the large and small airways can be affected.

Clinical Manifestations

Most children brought to the emergency department with LTB have been ill for a couple of days with upper respiratory symptoms. These symptoms progress to a cough and hoarseness. Fever may or may not be present. Common presenting signs are tachypnea, inspiratory stridor, and a seal-like barking cough.

Clinical Therapy

Diagnosis is often made by clinical signs. Pulse oximetry is used to detect hypoxemia. If the diagnosis of LTB is in question, anteroposterior (AP) and lateral x-rays of the up-
per airway are taken; these may show symmetric subglottic narrowing called a “steeple sign.” Throat cultures and visual inspection of the inner mouth and throat are contraindicated in children with LTB and epiglottitis. These procedures can cause laryngospasms (spasmodic vibrations that close the larynx) as a result of the child’s anxiety or of probing this reactive and already compromised area.

Clinical therapy consists of maintaining and improving respiratory effort with medications, humidification, and supplemental oxygen when the saturated oxygen level is less than 92% (see Table 47–5). Mist tents are rarely used for laryngotracheobronchitis.

Children with a good response to medications are often sent home from the emergency department after an observation period. Children with moderate to severe symptoms after medications are admitted for further observation and treatment. Airway obstruction is a potential complication of LTB. The child may require intubation and transfer to the ICU to maintain airway patency if obstruction is imminent. Most children, however, respond positively to the

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**TABLE 47–4** Summary of Croup Syndromes

<table>
<thead>
<tr>
<th>Acute Spasmodic Laryngitis (Spasmodic Croup)</th>
<th>VIRAL SYNDROMES</th>
<th>BACTERIAL SYNDROMES</th>
<th>Epiglottitis (Supraglottitis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity</td>
<td>Least serious</td>
<td>Most common</td>
<td>Guarded; requires close observation</td>
</tr>
<tr>
<td>Age affected</td>
<td>3 months to 3 years</td>
<td>3 months to 8 years</td>
<td>1 month to 13 years*</td>
</tr>
<tr>
<td>Onset</td>
<td>Abrupt onset; peaks at night, resolves by morning (recurs)*</td>
<td>Gradual onset; starts as URI, progresses to symptoms of respiratory distress</td>
<td>Progressive from URI (1-2 days)</td>
</tr>
<tr>
<td>Clinical manifestations</td>
<td>Afebrile; mild respiratory distress; barking-seal cough</td>
<td>Early: mild fever (&lt;39°C (102.2°F)); hoarseness; barking-seal, brassy, croupy cough; mhnorhea; sore throat; stridor (inspiratory); apprehension</td>
<td>Early: mild fever (&lt;39°C (102.2°F)); URI appears as viral croupy cough and croup initially; stridor (tracheal); purulent secretions</td>
</tr>
<tr>
<td>Etiology</td>
<td>Unknown; suspect viral with allergic/emotional influences</td>
<td>Parainfluenza, types I and II, RSV, or influenza</td>
<td>Parainfluenza, types I and II, RSV, or influenza</td>
</tr>
</tbody>
</table>

*Classic parameter or key point (distinguishes condition).
medications and oxygen therapy and are discharged within
48 to 72 hours.

**NURSING MANAGEMENT**

**NURSING ASSESSMENT AND DIAGNOSIS**

The initial and ongoing physical assessment of the child
with LTB focuses on adequacy of respiratory functioning. See Tables 47–6 and 47–7. Continuous monitoring is re-
quired to identify changes in airway patency. A means of
communication (sign language or simple word cues) must
be established so the older child can alert nursing staff to
respiratory difficulty.

Pay particular attention to the child’s respiratory ef-
fort, breath sounds, and responsiveness. Physical exhaus-
tion can diminish the intensity of retractions and stridor.
As the child uses the remaining energy reserve to maintain
ventilation, breath sounds may actually diminish. Noisy
breathing (audible airway congestion, coarse breath
sounds) in this situation verifies adequate energy stores.
Responsiveness decreases as hypoxemia increases.

The following nursing diagnoses might be appropriate
for the child with acute LTB:

- **Ineffective Breathing Pattern** related to tracheobronchial
  obstruction, decreased energy, and fatigue
- **Risk for Deficient Fluid Volume** related to inadequate
  fluid intake prior to admission
- **Fear (Child)** related to unfamiliar surroundings,
  procedures, and separation from support system

**PLANNING AND IMPLEMENTATION**

**Maintain Airway Patency**

Supplemental oxygen with humidity may be needed for hy-
poxemia. Cool mist is presumed to moisten airway secre-

---

TABLE 47–6 **Clinical Scoring System for Assessing Children with Stridor**

<table>
<thead>
<tr>
<th>Sign</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stridor</td>
<td>None</td>
<td>With agitation</td>
<td>Mild at rest</td>
<td>Severe at rest</td>
</tr>
<tr>
<td>Retraction</td>
<td>None</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td>Air entry</td>
<td>Normal</td>
<td>Normal</td>
<td>Decreased</td>
<td>Severe decrease</td>
</tr>
<tr>
<td>Color</td>
<td>Normal</td>
<td>Normal</td>
<td>Cyanotic with agitation</td>
<td>Cyanotic with rest</td>
</tr>
<tr>
<td>Level of consciousness</td>
<td>Normal</td>
<td>Restless if disturbed</td>
<td>Restless if undisturbed</td>
<td>Lethargic</td>
</tr>
</tbody>
</table>

Scoring: To quantify the severity of stridor, add the individual scores for each of the
sign categories. A score between 0 and 15 is possible. A rating of severity based on
total score is as follows: < 6 is mild, 7–8 is moderate, > 8 is severe.

Source: From Perkin, R. M., & Swift, J. D. (2002). Infectious causes of upper airway
obstruction in children. Pediatric Emergency Medicine Reports, 7(11), 120.

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TABLE 47–7 **Nursing Assessment of Child with Respiratory Difficulty**

<table>
<thead>
<tr>
<th>Nursing Action</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess heart rate and respiratory rate.</td>
<td>Tachypnea and tachycardia indicate increasing respiratory effort.</td>
</tr>
<tr>
<td>Check position of the child (sitting, prone, or supine)?</td>
<td>Upright or semi-Fowler’s promotes airway patency; the child’s own attempt or desire to change to a more upright position may signal increased distress.</td>
</tr>
<tr>
<td>Assess overall quality of respiratory effort. Determine inspiratory and expiratory breath sounds, ability to speak, and presence of stridor, cough, retractions, nasal flaring, cyanosis.</td>
<td>Reflects overall adequacy of airway and respiratory function.</td>
</tr>
<tr>
<td>Initiate stridor scoring assessment (Table 47–6), continue scoring every 30 minutes or more frequently if distress increases; initiate nursing actions appropriate for stridor score.</td>
<td>Provides consistent and objective assessment data with score for future comparison.</td>
</tr>
<tr>
<td>Attach cardiorespiratory monitor and pulse oximeter.</td>
<td>Provides continuous assessment data as part of ongoing physiologic monitoring.</td>
</tr>
</tbody>
</table>
tions and soothe the inflamed mucosa, but research has not documented its benefit (Perkin & Swift, 2002). Allow the child to assume a comfortable position. Be immediately available to attend to the child’s respiratory needs, and keep resuscitation equipment at the bedside.

**Meet Fluid and Nutritional Needs**

The respiratory distress may have interfered with the child’s ability and desire to drink fluids and compromised the child’s fluid status. Recognizing fluid deficit and monitoring the child’s hydration and nutritional status are essential. Fluids promote liquefaction of secretions and provide calories for energy and metabolism.

Children with LTB usually prefer cool, noncarbonated, nonacidic drinks such as oral rehydration fluids. The parents can be encouraged to give the child oral fluids. An intravenous infusion may be necessary to rehydrate the child, maintain fluid balance, or provide emergency access. Observe the child closely for difficulty in swallowing, which may be an early sign of epiglottitis or bacterial tracheitis.

**Discharge Planning and Home Care Teaching**

During the child’s observation period, take every opportunity to assess the parents’ knowledge of symptoms of LTB and discuss actions to take if symptoms recur. For example, instruct parents to call the child’s physician if:

- Mild symptoms do not improve after 1 hour of humidity and cool air treatment.
- The child’s breathing is rapid and labored.
- The child does not drink adequate fluids and the urine output is reduced.

**EVALUATION**

Expected outcomes of nursing care include the following:

- The child responds to medications with decreased respiratory distress.
- The child’s fear and anxiety is managed with family support and explanations about care.

**Epiglottitis (Supraglottitis)**

Epiglottitis (also known as supraglottitis) is an inflammation of the epiglottis, the long narrow structure that closes off the glottis during swallowing. Because edema in this area can rapidly (within minutes or hours) obstruct the airway by occluding the trachea, epiglottitis is considered a potentially life-threatening condition. (Table 47–4 compares epiglottitis and other croup syndromes.)

Epiglottitis is caused by bacterial invasion of the soft tissue of the larynx by streptococcus and staphylococcus, and by *Haemophilus influenzae* type B (Hib) in unimmunized children. The resulting inflammation and edema in the tissues and surrounding the epiglottis lead to airway obstruction. Since the widespread use of the Hib vaccination, a tenfold decrease in the incidence of epiglottitis has occurred (Isaacson & Isaacson, 2003).

Characteristically, a previously healthy child suddenly becomes very ill. The child initially develops a high fever (greater than 39°C [102.2°F]), with a sore throat, *dysphonia* (muffled, hoarse, or absent voice sounds), and *dysphagia* (difficulty in swallowing). As the larynx becomes obstructed, inspiratory stridor and respiratory distress develop. The intense throat pain keeps the child from swallowing, resulting in drooling. To fully open the airway and improve air intake, the child sits up and leans forward with the jaw thrust forward in the classic “sniffing” or tripod posture and refuses to lie down. The child’s anxiety increases as it becomes more difficult to breathe.

Diagnosis is often based on a lateral neck x-ray (Figure 47–2), which reveals a narrowed airway and an enlarged, rounded epiglottis, seen as a mass at the base of the tongue. Laryngospasm and airway obstruction can occur as a result of the severe irritation and hypersensitivity of the airway muscles. For this reason, *visual inspection of the mouth and throat is contraindicated in children with suspected epiglottitis*.

Immediate clinical therapy usually involves insertion of an endotracheal tube to maintain the airway. At the same time, a culture of the epiglottis is taken. Antibiotics effective for gram-positive organisms and *H. influenzae* are given until culture sensitivities are available. Antipyretics (acetaminophen, ibuprofen) may be useful in managing fever and sore throat pain.

![Enlarged, rounded epiglottis](Enlarged, rounded epiglottis) Narrow airway

The phrase "thumb sign" has been used to describe this enlargement of the epiglottis. Recall the trachea’s usual “little finger” size. Do you see the stiff, enlarged “thumb” above it in this lateral neck x-ray?
Nursing Management. Nursing management consists of airway management, drug therapy, hydration, and emotional and psychosocial support of the child and parents.

Until the child is intubated, the child is usually sedated and needs to be positioned to maintain the airway and breathe more easily. Observe the child’s respiratory and airway status closely and often. Note any change in level of consciousness. Anxiety-provoking procedures are postponed until the airway is stabilized. Crying stimulates the airway, increases oxygen consumption, and can precipitate laryngospasm. Supplemental humidified oxygen may be used initially to reverse hypoxemia.

Until the endotracheal tube is removed, the child is usually managed in the ICU to ensure continual observation. (See Skill 14–12, SKILLS.) Administer antibiotics to treat the infection and IV fluids to provide hydration. Because the child was febrile with a sore throat before admission, fluid intake may have been compromised.

The loss of voice, or even the inability to create sounds, can be frightening to a child. The unfamiliar hospital environment and strange equipment can create stress for child and parent alike. Reassure the parents that the child’s voice loss is temporary and explain the need for the various pieces of equipment.

Most children show rapid improvement once oxygen, antibiotics, and fluid therapy are started. The endotracheal tube can usually be removed within 24 to 36 hours (Hazinski, 1999). Home care may involve completing the course of antibiotics. Parents need instructions on proper administration and potential problems of drug therapy.

Bacterial Tracheitis
Bacterial tracheitis is a secondary infection of the upper trachea after viral laryngotracheitis that is most often caused by *Staphylococcus aureus*, group A *Streptococcus*, *Moraxella catarrhalis*, or *Haemophilus influenzae*. The disorder starts with croupy cough and stridor but progresses to include a high fever (greater than 39°C [102.2°F]), respiratory distress, and a toxic appearance (Stroud & Friedman, 2001). Table 47–4 compares bacterial tracheitis and other croup syndromes.

Because of the similarity of symptoms, bacterial tracheitis is often misdiagnosed initially as LTB. Instead of improving with therapy, however, the child’s condition becomes worse. Children generally prefer lying flat to sitting up. This seems to be a position of comfort that allows the child to conserve energy. Diagnosis is often made by blood cultures after the child is found unresponsive to usual LTB management. The subglottis is edematous with ulceration, and thick mucopurulent exudate may obstruct the airway. Antibiotics are given for a full 10- to 14-day course. Most children need a secured artificial airway for 3 to 11 days and ventilatory support.

Nursing Management. The child with bacterial tracheitis is frequently cared for in the PICU after intubation. Mechanical suctioning of the thick tracheal secretions that pool high in the upper airway helps maintain a patent airway. Provide humidified air or oxygen. Antibiotics are administered as ordered. The previous section on epiglottitis discusses other nursing care interventions that may also be appropriate for the child with bacterial tracheitis.

LOWER AIRWAY DISORDERS

The lower airway, or bronchial tree, lies below the trachea and includes the bronchi, bronchioles, and alveoli. Lower airway disorders occur because a structural or functional problem interferes with the lungs’ ability to complete the respiratory cycle. Lower airway disorders include bronchopulmonary dysplasia, bronchitis, bronchiolitis, pneumonia, and tuberculosis.

BRONCHITIS
Acute bronchitis, inflammation of the trachea and bronchi, rarely occurs in childhood as an isolated problem. The bronchi can be affected simultaneously with adjacent respiratory structures during a respiratory illness. Bronchitis is caused most often by a virus but may also result from invasion of bacteria or in response to an allergen or irritant.

The classic symptom of bronchitis is a coarse, hacking cough, which increases in severity at night. Children with bronchitis look tired. The chest and ribs may be sore because of the deep and frequent coughing. There is often a deep, rattling quality to breathing. Some children have audible wheezing that can be heard without a stethoscope. Treatment is palliative unless a secondary bacterial infection occurs.

NURSING MANAGEMENT
Nursing management includes supporting respiratory function through rest, humidification, hydration, and symptomatic treatment. Refer to the sections on asthma and pneumonia for detailed information on treatment measures.

Home care should emphasize the self-limiting nature of the disorder. Advise parents who smoke that quitting or refraining from smoking in the child’s presence may benefit the child.

BRONCHIOLITIS
Bronchiolitis is a lower respiratory tract illness that occurs when an infecting agent (virus or bacterium) causes inflammation and obstruction of the small airways, the bronchioles. The peak age for bronchiolitis is 2 to 6 months (Cooper, Banasiak, & Allen, 2003). Infection is most severe
in infants under 6 months of age and in children with heart and lung disease. Bronchiolitis is responsible for 90,000 hospital admissions and 4500 deaths per year (Agency for Healthcare Research and Quality, 2003).

**ETIOLOGY AND PATHOPHYSIOLOGY**

Infection with respiratory syncytial virus (RSV) is the most common cause, but other viral, bacterial, and mycoplasmal organisms may also be responsible. RSV occurs in annual epidemics from October to March. It is transmitted through direct or close contact with respiratory secretions of infected individuals. Nearly all children have been infected with RSV by 2 years of age, and reinfection (via siblings or close family contacts) throughout life is common (National Respiratory and Enteric Virus Surveillance System, 2000).

Viruses, acting as parasites, are able to invade the mucosal cells that line the small bronchi and bronchioles. The invaded cells die when the virus bursts from inside the cell to invade adjacent cells. The membranes of the infected cells fuse with adjacent cells, creating large masses of cells or “syncytia.” The resulting cell debris clogs and obstructs the bronchioles and irritates the airway. In response, the airway lining swells and produces excessive mucus. Despite this protective effort by the bronchioles, the actual effect is partial airway obstruction and bronchospasms.

**NURSING PRACTICE**

Respiratory syncytial virus (RSV) is the most common cause of lower respiratory tract infections in infants and children. RSV causes severe or fatal illness in infants with conditions such as congenital heart disease, bronchopulmonary dysplasia (BPD), prematurity, and immunosuppression. Healthcare workers should follow principles of good handwashing, as the virus is easily transmitted and can survive on the hands for 30 minutes or more (American Academy of Pediatrics, 2003).

The cycle is repeated throughout both lungs as the airways are invaded by the virus. The partially obstructed airways allow air in, but the mucus and airway swelling block expulsion of the air. This creates the wheezing and crackles in the airways. Air trapped below the obstruction also interferes with normal gas exchange, leading to hypoxemia. The child with RSV is therefore at risk for respiratory failure as the oxygen level decreases and the carbon dioxide level increases. Apnea and pulmonary edema may occur.

**CLINICAL MANIFESTATIONS**

The infant or child with bronchiolitis may have been ill with upper respiratory symptoms such as nasal stuffiness, cough (not usually noted in infants), and fever (less than 39°C [102.2°F]) for a few days. As the illness progresses and the lower respiratory tract becomes involved, symptoms increase and include inspiratory and expiratory wheezing; a deeper, more frequent cough; tachypnea; retractions; and more labored breathing. As severe respiratory distress develops, marked retractions, crackles, cyanosis, and diminished breath sounds are noted. Thus the noisier the lungs, the better, as this indicates that the child is still able to move air in and out of the lungs.

Parents report that the infant or child is acting more ill—appearing sicker, less playful, and less interested in eating. Infants, especially, may refuse to feed or may spit up what they do eat along with thick, clear mucus. Dehydration may be present.

**CLINICAL THERAPY**

The history and physical examination provide the data needed to diagnose bronchiolitis. Chest radiographs show nonspecific findings of inflammation. Enzyme-linked immunosorbent assay (ELISA) or direct fluorescent assay performed on a nasal wash specimen are laboratory tests used to identify the virus causing bronchiolitis (see Skills 10–13 and 10–14).

Children who test positive for RSV are isolated, roomed together, or placed on the same ward to minimize the spread of the virus to other hospitalized children. Supportive care is provided, especially when the causative agent is unknown and the condition is mild to moderate in severity. See Table 47–8 for clinical therapies. The child may be intubated and ventilated for apnea or respiratory failure. Ribavirin is the only antiviral drug available for treatment. Studies have not confirmed its effectiveness, so it is reserved for life-threatening cases (Wright, Pomerantz, & Luria, 2002).

The following high-risk infants are recommended to receive 5 monthly injections of palivizumab beginning in October or November to prevent RSV infection (American Academy of Pediatrics Committee on Infectious Diseases and Committee on Fetus and Newborn, 2003):

- Prematurity—born at 32 weeks of gestation or earlier, particularly if less than 6 months of age at the start of the RSV season.
- Chronic lung disease such as BPD who have required supplemental oxygen, bronchodilator, diuretic, or corticosteroid therapy within 6 months of the start of RSV season.
- Complicated congenital heart disease, particularly those on medication to control congestive heart failure, with cyanosis, and with moderate to severe pulmonary hypertension.
- Immunocompromised infants and children may benefit.
Clinical Therapy Rationale

Cardiorespiratory monitor and pulse oximetry

Humidified oxygen therapy via hood or face tent, mask, or nasal cannula

Intubation and assisted ventilation (PEEP/CPAP)

Hydration via intravenous or oral fluids

Systemic medications

Postural drainage and chest physiotherapy

**High-Risk Infant or Child**
- RespiGam (RSV immune globulin) IV
- Palivizumab (Synargis) IM

**TABLE 47–8 Clinical Therapy for Bronchiolitis**

<table>
<thead>
<tr>
<th>Clinical Therapy</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiorespiratory monitor and pulse oximetry</td>
<td>Enable provider to follow course and assess need for specific therapies.</td>
</tr>
<tr>
<td>Humidified oxygen therapy via hood or face tent, mask, or nasal cannula</td>
<td>Delivery method determined by desired concentration of oxygen, degree of moisture, and child’s response.</td>
</tr>
<tr>
<td>Intubation and assisted ventilation (PEEP/CPAP)</td>
<td>Used when the child becomes too fatigued to breathe effectively.</td>
</tr>
<tr>
<td>Hydration via intravenous or oral fluids</td>
<td>Provider must consider insensible fluid loss, decreased intake, the child’s current electrolyte and hydration status, and risk for pulmonary edema.</td>
</tr>
<tr>
<td>Systemic medications</td>
<td>Bronchodilators, steroids, and beta-antagonists act directly on inflamed and obstructed airways; bronchodilators help prevent apnea episodes in premature infants; nebulized epinephrine, and corticosteroids are occasionally used.</td>
</tr>
<tr>
<td>Postural drainage and chest physiotherapy</td>
<td>Helps to further loosen and mobilize trapped mucus.</td>
</tr>
</tbody>
</table>

**High-Risk Infant or Child**
- RespiGam (RSV immune globulin) IV
- Palivizumab (Synargis) IM

*Defined as a child with congenital heart disease, bronchopulmonary dysplasia, chronic lung problems, or cystic fibrosis or who is premature or severely ill and less than 6 months old.

Intravenous RSV immune globulin (RespiGam) may alternatively be used in some children under 2 years of age, and these children should wait 9 months before receiving live virus vaccines (varicella and MMR).

**NURSING MANAGEMENT**

**NURSING ASSESSMENT AND DIAGNOSIS**

**Physiologic Assessment**

Assess airway and respiratory function carefully. Good observation skills are important to ensure timely interventions for worsening respiratory symptoms and prevention of respiratory distress (see Table 47–1 and the clinical manifestations of respiratory failure on page 1392). An oxygen saturation level below 90% is the best indicator of the severity of the disease.

See “Nursing Care Plan: The Child with Bronchiolitis.”

**Psychosocial Assessment**

Observe children and their parents for signs of fear and anxiety (Table 47–9). The unfamiliar hospital environment and procedures can increase stress. Parents’ questions, as well as their nonverbal cues, help direct nursing interventions during admission and throughout hospitalization.

Common nursing diagnoses for the child with bronchiolitis include the following:

- **Ineffective Breathing Pattern** related to increased airway secretions, fatigue from coughing and dyspnea, and air trapping

  - **Activity Intolerance** related to imbalance between oxygen supply and demand
  - **Risk for Deficient Fluid Volume** related to inability to meet fluid needs and increased metabolic demands (insensible loss, fever, thickened or increased respiratory secretions)

**TABLE 47–9 Psychosocial Assessment of the Child with an Acute Respiratory Illness**

**Child**
- Assess for indications of anxiety or fear that may have an impact on respiratory status.
- For young children, ask about security objects (such as a blanket or doll), the child’s reaction to strangers, and reaction to absence of parents.
- For older children, ask whether this is the first hospital stay and what previous illness and hospital experiences have meant to the child.

**Parents**
- Assess parents’ reactions: Are they anxious? Fearful? Verbal or quiet? Asking appropriate questions?
- Observe for nonverbal cues. Often parents have financial worries (cost of hospital stay, lost work and wages) and personal worries (siblings at home who are ill) that they may not readily share with staff.
### THE CHILD WITH BRONCHIOLITIS

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Rationale</th>
<th>Expected Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Nursing Diagnosis:</strong> Ineffective Breathing Pattern related to increased work of breathing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NIC Priority Intervention:</strong> Respiratory monitoring: Collection and analysis of patient data to ensure airway patency and adequate gas exchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Goal:</strong> The child will return to respiratory baseline. The child will not experience respiratory failure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Assess respiratory status (Table 47–1) when child is calm and not crying a minimum of every 2–4 hours, or more often as indicated for an increasing or decreasing respiratory rate and episodes of apnea. Cardiorespiratory monitor and pulse oximeter are attached with alarms set. Record and report changes promptly to physician.</td>
<td>■ Changes in breathing pattern may occur quickly as the child's energy reserves are depleted. Assessment and monitoring provides objective evidence of changes in the quality of respiratory effort, enabling prompt and effective intervention.</td>
<td>The child returns to respiratory baseline within 48–72 hours.</td>
</tr>
<tr>
<td>■ NIC Priority Intervention: Respiratory monitoring: Collection and analysis of patient data to ensure airway patency and adequate gas exchange</td>
<td><strong>NOC Suggested Outcome:</strong> Vital signs status: Temperature, pulse, respiration, and blood pressure within expected range for the child’s age</td>
<td></td>
</tr>
<tr>
<td><strong>Goal:</strong> The child’s oxygenation status will return to baseline.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Administer humidified oxygen via mask, nasal cannula, hood, or tent.</td>
<td>■ Humidified oxygen loosens secretions, helps maintain oxygenation status, and eases respiratory distress.</td>
<td>The child’s respiratory effort eases. Pulse oximetry reading remains at 95% or higher oxygen saturation during treatment.</td>
</tr>
<tr>
<td>■ Assess pulse oximetry on room air and compare to reading when child is on oxygen.</td>
<td>■ Comparison of pulse oximetry readings provides information about improvement status.</td>
<td>The child tolerates therapeutic measures with no adverse effects.</td>
</tr>
<tr>
<td>■ Note child’s response to ordered medications.</td>
<td>■ Medications act systemically to improve oxygenation and decrease inflammation.</td>
<td>The child rests quietly in position of comfort.</td>
</tr>
<tr>
<td>■ Position head of bed up or place child in position of comfort on parent’s lap, if crying or struggling in crib or bed.</td>
<td>■ Position facilitates improved aeration and promotes decrease in anxiety (especially in toddlers) and energy expenditure.</td>
<td></td>
</tr>
<tr>
<td>■ Assess tolerance to feeding and activities.</td>
<td>■ Provides an assessment of condition improvement.</td>
<td></td>
</tr>
<tr>
<td>2. <strong>Nursing Diagnosis:</strong> Risk for Deficient Fluid Volume related to inability to meet body requirements and increased metabolic demand.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NIC Priority Intervention:</strong> Fluid management: Promotion of fluid balance and prevention of complications resulting from abnormal or undesired fluid levels</td>
<td><strong>NOC Suggested Outcome:</strong> Hydration: Amount of water in intracellular and extracellular compartments of body</td>
<td></td>
</tr>
<tr>
<td><strong>Goal:</strong> Child’s immediate fluid deficit is corrected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Evaluate need for intravenous fluids. Maintain IV, if ordered.</td>
<td>■ Previous fluid loss may require immediate replacement.</td>
<td>Child’s hydration status is maintained during acute phase of illness.</td>
</tr>
<tr>
<td>■ Calculate maintenance fluid requirements and give oral fluids, IV fluids, or both.</td>
<td>■ Assessment ensures child receives appropriate fluids to maintain hydration while transitioning to oral fluids.</td>
<td></td>
</tr>
<tr>
<td><strong>Goal:</strong> Child will be adequately hydrated, be able to tolerate oral fluids, and progress to normal diet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Maintain strict intake and output monitoring and evaluate specific gravity at least every 8 hours. Perform daily weight measurement on the same scale at the same time of day. Evaluate skin turgor.</td>
<td>■ Monitoring provides objective evidence of fluid loss and ongoing hydration status.</td>
<td>Child takes adequate oral fluids after 24–48 hours to maintain hydration.</td>
</tr>
</tbody>
</table>
| | ■ Further evidence of improvement of hydration status. | Child’s weight stabilizes after 24–48 hours; skin turgor is supple. | (continued)
## NURSING CARE PLAN—continued

### THE CHILD WITH BRONCHIOLITIS

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Rationale</th>
<th>Expected Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Nursing Diagnosis: Anxiety (Child and Parent) related to acute illness, hospitalization, uncertain course of illness and treatment, and home care needs</td>
<td>NIC Priority Intervention: Anxiety reduction: Minimizing apprehension, dread, foreboding, or uneasiness related to an unidentified source of anticipated danger</td>
<td>NOC Suggested Outcome: Anxiety control: Ability to eliminate or reduce feelings of apprehension and tension from an unidentifiable source</td>
</tr>
<tr>
<td>■ Encourage parents to express fears and ask questions; provide direct answers and discuss care, procedures, and condition changes. ■ Incorporate parents in the child’s care. Encourage parents to bring familiar objects from home. Ask about and incorporate in care plan the home routines for feeding and sleeping. ■ Provides opportunity to vent feelings and receive timely, relevant information. Helps reduce parents’ anxiety and increase trust in nursing staff. ■ Familiar people, routines, and objects decrease the child’s anxiety and increase parents’ sense of control over an unexpected, uncertain situation.</td>
<td>Goal: Child and parents will demonstrate behaviors that indicate decrease in anxiety. Parents and child show decreasing anxiety and decreasing fear as symptoms improve and as child and parents feel more secure in hospital environment. Parent freely asks questions and participates in the child’s care. The child cries less and allows staff to hold or touch him or her.</td>
<td></td>
</tr>
<tr>
<td>■ Explain symptoms, treatment, and home care of bronchiolitis. ■ Provide written instructions for follow-up care arrangements, as needed. ■ Anticipate potential for recurrence. Assist family to be prepared should respiratory symptoms recur after discharge. ■ Written, as well as oral, instructions reinforce knowledge. Parents may not “hear” and remember the particulars of home care if presented only orally.</td>
<td>Goal: Parents will verbalize knowledge of bronchiolitis symptoms and use of home care methods before the child’s discharge from the hospital. Parent accurately describes respiratory symptoms and initial home care actions.</td>
<td></td>
</tr>
</tbody>
</table>

### PLANNING AND IMPLEMENTATION

Nursing management focuses on maintaining respiratory function, supporting overall physiologic function and hydration, reducing the child’s and family’s anxiety, and preparing the family for home care.

#### Maintain Respiratory Function

Close monitoring is essential to evaluate the child’s improvement or to spot early signs of deterioration. Administer oxygen and pulmonary care therapies. High humidity and supplemental oxygen may be provided with a mist tent if the child requires only moisture and minimal oxygen. If more concentrated oxygen is required, it can be given via nasal cannula, hood, or tent. Use pulse oximetry to evaluate oxygenation.

Patent nares are important to promote oxygen intake. A bulb syringe and saline nose drops can be used to quickly clear the nasal passages. Elevate the head of the bed to ease the work of breathing and drain mucus from the upper airways. Chest physiotherapy is often administered by a respiratory therapist.

#### Support Physiologic Function

Grouping nursing tasks promotes the child’s physiologic function by decreasing stress and promoting rest. Medica-
Advise parents to call the physician if:

- Respiratory symptoms interfere with sleep or eating.
- Breathing is rapid or difficult.
- Symptoms persist in a child who is less than 1 year old, has heart or lung disease, or was premature and had lung disease after birth.
- The child acts sicker—appears tired, less playful, and less interested in food (parents just “feel” the child is not improving).

**Reduce Anxiety**

The need for hospitalization and assistive therapies creates anxiety and fear in the child and parents. An important part of nursing care is anticipating, recognizing, and acting to decrease the child’s and parents’ anxiety. The parents may be frightened by the child’s continued respiratory difficulty and the assistive equipment at the bedside. Provide parents with thorough explanations and daily updates, and encourage their participation in the child’s care. Reassure them that holding or touching the child will not dislodge wires or tubing, and that their presence will calm and support the child.

If the child has been ill for a few days before admission, the parents are likely to be tired. Acknowledging parents’ physical and emotional needs creates a spirit of caring and enhances communication between staff and family. Encourage the parents to take turns at the child’s bedside and to take breaks for meals and rest.

**Discharge Planning and Home Care Teaching**

Children are discharged once they show sufficient stability in maintaining adequate oxygenation (as evidenced by easing of respiratory effort, decreased mucus production, and absence of coughing). In most children, symptoms abate within 24 to 72 hours; however, resolution of all symptoms may take weeks. The same supportive therapies implemented in the hospital may be needed at home:

- Use of the bulb syringe to suction the nares of an infant under 1 year of age (see Skill 14–20)
- Fluid intake to thin respiratory secretions (making them easier to clear) and provide glucose for energy (since the child’s appetite may not return to normal for several days)
- Rest

Children can usually recognize their own activity limits. However, parents should encourage active toddlers to nap and take rest periods. Teach the parents proper administration of medications. Acetaminophen may be prescribed for persistent low-grade fevers and general discomfort. Advise parents that RSV infection can recur; therefore, they need to know how to recognize symptoms and when to call the physician.

**PNEUMONIA**

Pneumonia is an inflammation or infection of the bronchioles and alveolar spaces of the lungs. It occurs most often in infants and young children. Pneumonia in children often resolves much sooner than in adults. The key is early recognition, enabling the child to be managed at home rather than in the hospital.

Pneumonia may be viral, mycoplasmal, or bacterial in origin. In children under 5 years, pneumonia is most often caused by viruses such as RSV, influenza, parainfluenza virus, adenovirus, rhinovirus, and enterovirus. In children over 5 years, pneumonia is caused by bacteria, such as *Streptococcus pneumoniae*. Children with a condition such as cystic fibrosis or immunosuppression are susceptible to many other bacterial, parasitic, or fungal infections.

What physiologic process occurs to precipitate the symptoms? Bacterial and viral invaders act differently within the lungs:

- Bacterial invaders circulate through the bloodstream to the lungs, where they damage cells. Cellular debris and mucus cause airway obstruction. Bacteria tend to be distributed evenly throughout one or more lobes of a single lung, a pattern termed *unilateral lobar pneumonia*.
- Viruses frequently enter from the upper respiratory tract, infiltrating the alveoli nearest the bronchi of one
or both lungs. There they invade the cells, replicate, and burst out forcefully, killing the cells and sending out cell debris. They rapidly invade adjacent areas, distributing themselves in a scattered, patchy pattern referred to as bronchopneumonia.

- Aspiration of food, emesis, gastric reflux, or hydrocarbons causes a chemical injury and inflammatory response. Materials with a lower pH cause more inflammation which sets the stage for bacterial invasion.

Regardless of the causative agent, symptoms include fever, rhonchi, crackles, wheezes, cough, dyspnea, tachypnea, restlessness, and decreased breath sounds if consolidation exists.

Diagnosis is made by chest radiograph, which shows an abnormal density of tissue, such as a lobar consolidation. There is no clinical way to differentiate bacterial and viral cause. The child’s age, severity of symptoms, and presence of an underlying lung, cardiac, or immunodeficiency disease can create varying responses.

Clinical management for all types of pneumonia includes symptomatic therapy (pain and fever control) and supportive care through airway management, fluids, and rest. Mycoplasma and other bacterial pneumonias are treated with organism-sensitive antibiotics; viral pneumonias usually improve without antibiotics. Some children need oxygen and IV fluids to maintain hydration.

**NURSING MANAGEMENT**

Most children with pneumonia are cared for at home. Nursing care incorporates supportive measures and medical therapies as appropriate. Nursing measures used to manage the child with bronchiolitis are generally applicable to the child with pneumonia.

In addition to ongoing respiratory assessment and supportive therapies (chest physiotherapy, antibiotics, hydration), the child may need relief from pain when coughing and deep breathing. Teach the child and parent how to splint the chest, by hugging a small pillow, teddy bear, or doll, to make coughing less painful. Pain medication (acetaminophen or ibuprofen) can provide the added benefits of temperature control and may aid in sleep.

The goal of nursing care is to restore optimal respiratory function. Medications, especially antibiotics, must be taken at prescribed intervals and for the full course. Teach parents the proper administration of drugs and any side effects. Follow-up may include a chest radiograph to see if the lungs are clear. Symptoms of pneumonia usually disappear long before the lungs are completely healed. Some children continue to have worsening reactive airway problems or abnormal results on pulmonary function tests. Most children, however, recover uneventfully.

Preventive measures against pneumonia are limited. A 23-valent pneumococcal vaccine is recommended for children over 2 years of age who are immunosuppressed or have chronic diseases. (See Immunization information in Chapter 45.

**TUBERCULOSIS**

Tuberculosis (TB) is caused by the organism *Mycobacterium tuberculosis*, which is transmitted through the air in infectious particles called droplet nuclei. The overall incidence of TB in the United States is 5.1 cases per 100,000 people. More than 50% of new cases of TB in the United States occur in individuals who are foreign-born (Centers for Disease Control, 2004). The risk of developing TB is greatest during the first 2 years of life and during adolescence (American Thoracic Society, 2000). Adolescents are more likely to develop TB because of hormonal changes and metabolic changes associated with growth spurts (Morisky, Malotte, Ebin et al., 2001). Children with altered immune status are also at risk. In young children, the disease develops as an immediate complication of the primary infection.

Adults with active laryngeal or pulmonary TB may transmit the disease to children. By coughing, sneezing, speaking, or singing, a person with active TB sends out tiny droplets of moisture that remain in the air. If these droplets are inhaled, the bacillus is small enough to travel directly to the alveoli and cause infection. Frequently, however, the organism is trapped in the upper airway, preventing infection.

Once the organism reaches the alveoli, an immune response is initiated and macrophages surround and wall off the bacillus in small hard capsules, called tubercles. There the bacillus can remain dormant (inactive) indefinitely or can progress to active TB. The tubercle bacillus grows slowly, dividing within the macrophage. When the organisms number 1000 to 10,000 after 2 to 12 weeks, cellular immune response to TB can be elicited with the TB skin test. The tubercle bacilli may spread by the lymphatic system to the hilar lymph nodes and then to the bloodstream and other sites, resulting in TB meningitis or miliary (disseminated) TB. This systemic form of TB (meningeval or miliary tuberculosis) may lead to serious illness or death. Miliary tuberculosis is not, however, transmissible; only active pulmonary TB has the potential to infect another individual.

Clinical manifestations of TB in infants include a persistent cough, weight loss or failure to gain weight, and fever. Wheezing and decreased breath sounds may be present. Children with active TB may have fatigue, cough, anorexia, weight loss or growth delay, night sweats, chills, and a low-grade fever. Infants, children, and adolescents with latent TB (exposed and infected) are asymptomatic.
See Table 47–10 for the tests used to confirm the diagnosis. Medical management focuses on diagnosis and treatment of active TB with antitubercular drugs, including isoniazid, rifampicin, pyrazinamide, ethambutol, and streptomycin. Therapy usually involves a 6-month regimen of two or more of these drugs. Children with latent TB receive a single daily dose of isoniazid for 9 months. Challenges to treatment have occurred with the development of multidrug-resistant TB organisms. Tuberculosis is a major public health problem and must be promptly reported to local health departments.

In suspected cases of tuberculosis, the child, immediate family, and supposed carrier should be skin tested for TB. Intradermal testing using purified protein derivative (PPD, the Mantoux test) is considered the most accurate test. For interpretation of PPD tests in children, see the Companion Website. A control skin test verifies the response status of the immune system. Children who should receive a TB skin test include those with a TB contact, with TB-suggestive radiologic or clinical findings, who travel to a TB endemic area, who have contact with adults from TB endemic countries, who are incarcerated adolescents, who have contact with persons at high risk for TB (positive HIV status), who are beginning immunosuppression therapy, or who reside in a high-risk neighborhood (American Academy of Pediatrics, 2003).

### TABLE 47–10  
Diag nostic Tests for Tuberculosis

<table>
<thead>
<tr>
<th>Test</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mantoux test (intradermal injection of 5 tuberculin units of purified protein derivative [PPD])</td>
<td>A positive test confirms infection with the TB organism and production of antibodies (3–12 weeks after exposure)</td>
</tr>
<tr>
<td>Chest radiograph (anteroposterior and lateral views)</td>
<td>Confirms presence of pulmonary tuberculosis (small, seedlike opacities may be visible)</td>
</tr>
<tr>
<td>Blood cultures for <em>Mycobacterium tuberculosis</em></td>
<td>Proves diagnosis; defines specific drug sensitivity</td>
</tr>
<tr>
<td>Gastric washings (early morning after overnight fast; 3 consecutive days)</td>
<td>Confirms pulmonary TB. Used in children under 12 years because they do not produce sputum.</td>
</tr>
<tr>
<td>Sputum cultures (expectorated or from bronchoscopic examination)</td>
<td>Confirms active pulmonary tuberculosis</td>
</tr>
<tr>
<td>Pleural biopsy for culture and tissue examination</td>
<td>Taken when pleural effusion is present</td>
</tr>
<tr>
<td>Lumbar puncture</td>
<td>Confirms meningeal TB</td>
</tr>
</tbody>
</table>

NURSING MANAGEMENT

Nursing care centers on administering medications and providing supportive care. Teach parents about the disease process, medications, possible side effects, and the importance of long-term therapy (e.g., that drug therapy may last for 6 to 12 months). Emphasize the importance of taking medications as prescribed on an empty stomach. Children with tuberculosis should receive “directly observed drug therapy” administered by a nurse or other healthcare provider to ensure the drug is being taken. Direct observation should be done daily for at least 2 weeks and then decreased to twice a week if the patient is responding to treatment (Stowe & Jacobs, 1999). Children with latent TB should receive “directly observed drug therapy” twice a week (American Academy of Pediatrics, 2003).

Encourage proper nutrition and rest to promote normal growth and development. The child can return to school or child care when effective therapy has been instituted, adherence to therapy has been documented, and clinical symptoms have diminished substantially (American Academy of Pediatrics, 2003). Most children with TB can lead essentially normal lives. The discussion of pneumonia earlier in this chapter and the discussion of tubercular meningitis in Chapter 53 give other nursing care measures appropriate for the child with TB.

CHRONIC LUNG DISEASES

BRONCHOPULMONARY DYSPLASIA

Bronchopulmonary dysplasia (BPD), also called chronic lung disease, is the most serious chronic respiratory disorder that begins during infancy. It results from an acute respiratory disease during the neonatal period. Risk factors for developing BPD include prematurity, lung immaturity, high inspired oxygen concentrations, positive pressure ventilation, patent ductus arteriosus, and vitamin A deficiency. It is estimated that 10% to 35% of very low-birthweight infants develop BPD (Froh, 2002).

BPD results from positive pressure ventilation and oxygen treatment for respiratory distress syndrome and inflammatory changes to the airways (see newborn respiratory distress information in Chapter 30). Interruption in alveolar development occurs when preterm infants need mechanical ventilation and supplemental oxygen. Inflammation and persistent hypoxia lead to cellular damage, fibrosis, and edema of the bronchioles. Other disorders that contribute to the development of BPD include neonatal pneumonia, meconium aspiration syndrome, fluid overload, and lung hypoplasia (Capper-Michel, 2004).

The infant with BPD has persistent signs of respiratory distress: tachypnea, wheezing, crackles, irritability, nasal
flaring, grunting, retractions, pulmonary edema, and failure to thrive. The infant has intermittent bronchospasms and mucous plugging. Infants may have episodes of sudden respiratory deterioration with tracheobronchial narrowing and associated expiratory airflow limitations that may be caused by a sudden increase in pulmonary vascular resistance. Cyanosis may be seen in severe cases. Normal activities, such as feeding, can create increased oxygen demands that are difficult for the compromised infant to meet.

The chest radiograph often shows hyperexpansion, atelectasis, and interstitial thickening (Capper-Michel, 2004). The air trapping persists and in time causes the chest to assume a barrel shape (see “Pathophysiology Illustrated: Barrel Chest”). Medical management focuses on symptomatic treatment that supports respiratory function and on good nutrition, which helps to accelerate lung maturity. Supplemental oxygen with humidity is used to keep the pulse oximetry between 92% and 97% even during sleep and feeding, but high concentration oxygen is avoided to prevent further lung injury (Grant & Curley, 2001). A tracheostomy may be performed for long-term airway management to prevent narrowing of the trachea. Chest physiotherapy and medications (diuretics, bronchodilators, anti-inflammatories, and inhaled corticosteroids) are also used (Table 47–11). With improvement and adequate weight gain, the child is weaned off oxygen, diuretics, and bronchodilators. Long-term sequelae include asthma and respiratory infections with frequent rehospitalization rates. Potential long-term outcomes of BPD include developmental delays, growth retardation, impaired cognitive function, and pulmonary dysfunction in adolescents (Belcastro, 2004).

**Nursing Management**

Nursing management focuses on promoting respiratory function and preparing the family for home care needs. Infants with BPD do not have the same respiratory reserve as healthy infants, and they may become acutely ill at any time. During hospitalization for acute infections, a cardiorespiratory monitor and pulse oximeter are used. Assess airway and respiratory function, vital signs, color, and behavior changes to identify signs of worsening respiratory symptoms, even when oxygen is provided. Position the infant to facilitate breathing. Observe for airway obstruction when the infant has a tracheostomy and suction as needed. Organize care to reduce unnecessary physical stimulation.

Provide fluids and nutrition to meet energy needs; however, fluid management is important to prevent excess

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**TABLE 47–11 Medicaions Used to Treat Bronchopulmonary Dysplasia**

<table>
<thead>
<tr>
<th>Medication</th>
<th>Action/Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchodilators (beta-2-adrenergics, anticholinergics, theophylline, albuterol nebulizer)</td>
<td>Decreases airway resistance; increases expiratory flow in small airways; stimulates mucous clearance; different drugs work together for best response</td>
</tr>
<tr>
<td>Anti-inflammatory agents (corticosteroids, inhaled cromolyn, beclomethasone)</td>
<td>Reduces pulmonary edema and inflammation in small airways; enhances effect of bronchodilators; helps decrease the need for other drugs and oxygen; for moderate disease only</td>
</tr>
<tr>
<td>Diuretics (furosemide, chlorothiazide, spironolactone)</td>
<td>Helps remove excess fluid from lungs; decreases pulmonary resistance and increases pulmonary compliance; may cause electrolyte imbalances</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>Prevents electrolyte imbalances associated with diuretics</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Low-dose prophylactic therapy to prevent severe illness; specific treatment for identified organisms</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>Plays a role in normal lung development</td>
</tr>
<tr>
<td>Palivizumab, RSV immune globulin</td>
<td>Prevents respiratory syncytial virus</td>
</tr>
</tbody>
</table>
HEALTH PROMOTION

The Child with Bronchopulmonary Dysplasia

Health Supervision
- Assess blood pressure to detect abnormal findings associated with pulmonary hypertension.
- Perform hematocrit frequently during the first year of life to assess for anemia.
- Perform a chest radiograph and pulmonary function tests annually or as needed for clinical condition.
- Perform routine hearing assessment at each visit.
- Coordinate vision screening by an ophthalmologist every 2-3 months during the first year of life. Myopia and strabismus are common resulting from oxygen therapy as a premie.
- Coordinate pulmonary function tests annually or as needed for clinical condition.
- Perform other screening tests as recommended for age.

Growth and Developmental Surveillance
- Assess growth and plot measurements on a growth chart corrected for gestational age. Even if length and weight are lower than normal, monitor for continued growth following the growth curves.
- Perform the Denver II and record the developmental assessment corrected for gestational age.

Nutrition
- Review caloric intake and ensure that intake is optimal for growth. Assess difficulties with feeding related to oral motor function. Refer to a nutritionist as necessary.

Physical Activity
- Organize care so that child has periods of time to rest during the day.

Relationships
- Identify ways to coordinate care during the night to reduce number of times child and family have sleep disturbed.
- Provide discipline appropriate for developmental age.
- Encourage development. Provide developmentally appropriate toys and activities.

Disease Prevention Strategies
- Reduce exposure to infections. If out-of-home child care is used, select a provider caring for a small number of children. If possible, avoid the use of childcare centers during RSV season.
- Immunize the child with the routine schedule based on chronologic age.
- Give the influenza vaccine annually and 23-valent pneumococcal vaccine at 2 years of age.
- Provide monthly injections of palivizumab throughout the RSV season to protect the child from respiratory syncytial virus.

Condition-Specific Guidance
- Develop an emergency care plan for times when the infant’s condition rapidly worsens.

ASTHMA

Asthma (also called bronchial asthma) is a chronic inflammatory disorder of the airway with airway obstruction that

fluids and pulmonary edema. Administer medications as ordered. A formula supplemented with carbohydrates and medium chain triglycerides may be given to promote weight gain. Some children need nasogastric or gastrostomy tube feedings to get adequate nutrition when cyanosis is noted with feeding.

Once home, many infants need ventilation therapy, oxygen respiratory support, and drug therapy (Figure 47–3). Some families need home nursing assistance. Carefully plan and coordinate referrals for needed respiratory supplies, medications, an early intervention program, and follow-up care well in advance of the infant’s discharge. Teach parents to identify the signs of respiratory compromise indicating a need for rapid intervention. Suggest ways to provide for the infant’s normal development through rest, nutrition, stimulation, and family support. During regular follow-up visits, ensure that the infant receives RSV prophylaxis as described on page 1405.
Asthma is a chronic condition with acute exacerbations or persistent symptoms. Children require continuous coordinated care to control sudden symptoms and minimize long-term airway changes. Although unusual in the past, severe persistent asthma is more common now. Hospitalizations for asthma as well as mortality from asthma in children have increased significantly (Akinbami & Schoendorf, 2002).

**ETIOLOGY AND PATHOPHYSIOLOGY**

Asthma is a chronic inflammatory disease of the lungs that is caused by multiple factors, including environmental exposures, viral illnesses, allergens, and a genetic predisposition. Several chromosomes are thought to be factors in asthma susceptibility, including chromosomes 5q, 6p, 11q, 12q, and 13q (Foley, 2002). Exposure to environmental factors early in life or in utero is thought to stimulate the onset of asthma. A recent report found strong evidence that house dust mites and environmental tobacco smoke, and suggestive evidence that cockroaches, infections with RSV, and mold from indoor home dampness contributed to the development of asthma (Institute of Medicine, 2000).

Inflammation causes the normal protective mechanisms of the lungs (mucus formation, mucosal swelling, and airway muscle contraction) to react excessively in response to a stimulus and cause airway obstruction. The stimulus, or *trigger*, that initiates an asthmatic episode can be inflammatory or noninflammatory. Triggers increase the frequency and severity of smooth muscle contraction, and airway responsiveness is enhanced through inflammatory mechanisms. Asthmatic triggers include exercise, viral or bacterial agents, allergens (mold, dust, pollen, furry pets, birds), fragrances, food additives, pollutants, weather changes (humidity and temperature), and emotions. Exercise triggers a bronchospasm by the rapid breathing of cooler and drier air than the air in the respiratory tract (Baker, Friedman, & Schmitt, 2002).

The reactive airway responses to stimuli are present before the trigger initiates the asthmatic episode. During the acute allergic reaction, an antigen binds to the specific immunoglobulin E surface on the mucosal mast cells, and histamine is released along with intercellular chemical mediators (leukotrienes, prostaglandins, platelet-activating factor, and certain cytokines) resulting in bronchospasm, mucosal edema, and mucus secretion. The late allergic response starts 6 to 9 hours later when inflammatory cells respond and another wave of mediator release occurs. This stimulates more airway inflammation and bronchospasm (Kieckhefer & Ratcliffe, 2004).

Bronchial constriction, airway swelling, and production of copious amounts of mucus causes airway narrowing. Mucus clogs small airways and traps air (see “Pathophysiology Illustrated: Asthma”). The airways can be partially or completely reversed, and increased airway responsiveness to stimuli (Kieckhefer & Ratcliffe, 2004). It is the most common chronic illness, affecting nearly 9 million children in the United States (National Center for Health Statistics, 2004). Affected children have about 10 days of school absenteeism and 20 days of restricted activity per year (Sydnor-Greenberg & Dokken, 2000). Nearly 53 per 1000 children between 0 and 17 years of age have an asthma attack during a year (Centers for Disease Control and Prevention, National Center for Health Statistics, 2001). Most children with asthma experience their first symptoms before the age of 5 years. See the Companion Website for links.

Passive smoke exposure (secondhand smoke), contaminants in indoor air (pet dander, dust mites, cockroach feces, fungal contamination, chemical gases), and pollutants in outdoor air all contribute significantly to the development of asthma and respiratory problems in children (Solomon, Humphreys, & Miller, 2004). Passive smoke exposure has been linked to an increase in asthma symptoms, emergency department visits, and hospital admissions in children of parents who smoke, as well as to decreased lung function (Gilliland, Yu-Fen, & Peters, 2001; Mannino, Homa, & Redd, 2002).
The Child with Alterations in Respiratory Function

swell, creating muscle spasms that may become uncontrolled in the large airways. Decreased perfusion of the alveolar capillaries results from hyperinflation of the alveoli. Hypoxemia leads to an increased respiratory rate, but less air is breathed per minute because of airway resistance. Progressive chronic inflammatory changes result in airway remodeling, an irreversible thickening of the basement membrane, airway smooth muscle hypertrophy, and mucus gland hypertrophy (Froh, 2002).

Moderate anxiety occurs as the asthma episode begins, and increases as the episode intensifies. Severe anxiety intensifies physical responses and symptoms, and a vicious cycle is established. Recognizing and addressing the child’s fear and panic are essential for reestablishing normal respirations.

Clinical Manifestations. Asthma is characterized by airway inflammation, airway obstruction or narrowing, and airway hyperreactivity. The sudden appearance of breathing
difficulty (cough, wheeze, or shortness of breath) is often referred to as an asthma episode or “asthma attack.” The infant or child who has had episodes of frequent coughing or frequent respiratory infections (especially pneumonia or bronchitis) should also be evaluated for asthma. The coughing, especially at night, is the warning signal that the child’s airway is very sensitive to stimuli; it may be the only sign in “silent” asthma.

During an acute episode, respirations are rapid and labored and the child often appears tired because of the ongoing exertion of breathing. Nasal flaring and intercostal retractions may be visible. The child exhibits a productive cough and expiratory wheezing, use of accessory muscles, decreased air movement, and respiratory fatigue. In cases of severe obstruction, wheezing may not be heard because of the lack of airflow. The resulting hypoxia, as well as the cumulative effect of previously administered medications, contributes to behaviors ranging from wide-eyed agitation to lethargic irritability. See “Clinical Manifestations: Asthma in Children by Severity of Acute Exacerbations.” In children who have repeated acute exacerbations, a barrel chest and the use of accessory muscles of respiration are common findings.

Clinical Therapy. The diagnosis of asthma has four key elements: symptoms of episodic airflow obstruction, partial reversibility of bronchospasm with bronchodilator treatment, exclusion of alternative diagnosis, and confirmation by spirometry of measurement of forced expiratory flow variability. A spirometer measures the volume of air a child can expel from the lungs after a maximum inspiration. Three readings of the forced vital capacity and forced expiratory volume are taken and compared to predicted normal values to assess the severity of airway obstruction. Because the test requires children to

<table>
<thead>
<tr>
<th>ASSESSMENT CRITERIA</th>
<th>MILD</th>
<th>MODERATE</th>
<th>SEVERE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak expiratory flow rate (PEFR)(^a)</td>
<td>70%-90% predicted or personal best</td>
<td>50%-70% predicted or personal best</td>
<td>Less than 50% predicted or personal best</td>
</tr>
<tr>
<td>Respiratory rate, resting or sleeping</td>
<td>Normal to 30% increase above the mean</td>
<td>30%-50% increase above mean</td>
<td>Increase over 50% above mean</td>
</tr>
<tr>
<td>Alertness</td>
<td>Normal</td>
<td>Normal</td>
<td>May be decreased</td>
</tr>
<tr>
<td>Dyspnea(^b)</td>
<td>Absent or mild; speaks in complete sentences</td>
<td>Moderate; speaks in phrases or partial sentences; infant’s cry softer and shorter; has difficulty sucking and feeding</td>
<td>Severe; speaks only in single words or short phrases; infant’s cry softer and shorter; stops sucking and feeding</td>
</tr>
<tr>
<td>Pulsus paradoxus(^c)</td>
<td>Less than 10 mm Hg</td>
<td>10-20 mm Hg</td>
<td>20-40 mm Hg</td>
</tr>
<tr>
<td>Accessory muscle use</td>
<td>No intercostal to mild retractions</td>
<td>Moderate intercostal retractions with tracheosternal retractions; use of sternocleidomastoid muscles; chest hyperinflation</td>
<td>Severe intercostal retractions, tracheosternal retractions with nasal flaring during inspiration; chest hyperinflation</td>
</tr>
<tr>
<td>Color</td>
<td>Good</td>
<td>Pale</td>
<td>Possibly cyanotic</td>
</tr>
<tr>
<td>Auscultation</td>
<td>End-expiratory wheeze only</td>
<td>Wheeze during entire expiration and inspiration</td>
<td>Breath sounds becoming inaudible</td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td>Greater than 95%</td>
<td>90%-95%</td>
<td>Less than 90%</td>
</tr>
<tr>
<td>(\text{Pco}_2)</td>
<td>Less than 35</td>
<td>Less than 40</td>
<td>Greater than 40</td>
</tr>
</tbody>
</table>

Note: Within each category, the presence of several parameters, but not necessarily all, indicates the general classification of the exacerbation.

\(^a\)For children 5 years of age or older.

\(^b\)Parents’ or physicians’ impression of degree of children’s breathlessness.

\(^c\)Pulsus paradoxus does not correlate with phase of respiration in small children.

cooperate and follow instructions, it is usually administered to children over 4 or 5 years of age. Skin testing may be used to identify allergens (asthma triggers).

Medical management includes medications, support of parents and child, and education. Pharmacologic treatment is matched to the severity of asthma for long-term control and for management of acute episodes. See Table 47–12 for nationally recommended guidelines for the treatment of children over 5 years of age with acute and chronic asthma. Control of asthma symptoms is the goal, and if control is not achieved with the regimen prescribed, then the regimen should be changed to correspond to the next step in asthma severity. Once control of asthma symptoms is achieved, the treatment plan can be reviewed in 1 to 6 months to determine if a step back in asthma treatment is appropriate (Hogan & Wilson, 2003). See Table 47–13 for medications used to treat asthma.

Some healthcare providers encourage children to use a peak expiratory flow meter to identify when an obstruction is occurring. This device measures the child’s ability to push air forcefully out of the lungs, similar to a spirometer. Medication administration can be based on peak expiratory flow rate (PEFR) readings and the effectiveness of treatment confirmed by improved PEFR numbers.

See “Clinical Pathway: Stages of Inpatient Care for Children with Severe Asthma.”

Most children with acute exacerbations respond to aggressive management in the emergency department. Children who do not respond or who are already being managed at home on corticosteroids have a greater chance of being admitted. Some children need mechanical ventilation.

### DRUG GUIDE

#### ALBUTEROL

**Overview of Action**
A synthetic sympathomimetic amine and moderately selective beta2-adrenergic agonist that has effect on bronchial, uterine, and vascular supply to muscles. Produces bronchodilation, decreases airway resistance, facilitates mucus drainage, and increases vital capacity.

**Routes, Dosage, Frequency**

**Oral**
- **2 to 6 years:** Initial: 0.1–0.2 mg/kg/day 3 times a day (maximum dosage 4 mg/dose)
- **6 to 12 years:** 2 mg 3 to 4 times per day
- **Over 12 years:** 2 to 4 mg 3 to 4 times per day; extended-release tablets: 4 to 8 mg every 12 hours

**Inhalation:** Oral inhalation for relief of acute bronchospasms or prevention of asthma symptoms
- **6 to 12 years:** 1 to 2 inhalations every 4 to 6 hours

**Contraindications:** Hypersensitivity to drug or its ingredients.

**Side Effects:** Restlessness, nervousness, tremors, dizziness, weakness, headache, hallucination, insomnia, tachycardia, palpitations, hypertension or hypotension, peripheral vasodilation, irritation of nose and throat, blurred vision, dilated pupils, muscle cramps, hoarseness.

**Nursing Implications**

**Assessment:** Assess the respiratory status and obtain baseline pulse and peak expiratory flow rate.

**Administer:** For oral: Plain tablets can be crushed and mixed with small amounts of food or fluids. Do not crush coated tablets. Side effects are more common with oral form. Inhalation: Shake container well. If second inhalation is prescribed, manufacturer recommends that 1 minute elapse between doses. Nebulizer: Follow agency policy for operation of the nebulizer apparatus. Follow package insert directions for solution dilution. If solution is discolored, do not use. Do not remove nebulization capsules from the original package until just prior to use.

**Monitor:** Monitor pulse (cardiovascular effects may occur), central nervous system stimulation (hyperactivity, excitement, nervousness, insomnia), therapeutic response to medication. Maintain hydration for weight. Do not use over-the-counter drugs (e.g., cold preparations) without physician approval as many contain drugs that intensify albuterol action. Perform periodic arterial blood gases, pulmonary function tests, and pulse oximetry.

**Patient teaching:** Review directions for correct use of medication. Teach the proper use and care of the inhaler. Have child demonstrate inhaler use. Emphasize that inhaler should not be used more frequently than prescribed, and to contact physician if albuterol fails to provide relief. Avoid contact of inhalation drug with eyes. Help the family ensure that child has access to medicine during school hours if needed.

### TABLE 47–12 Asthma Severity Classification and Preferred Clinical Therapy for Children Older than 5 Years of Age

<table>
<thead>
<tr>
<th>Classification (Steps)</th>
<th>Description</th>
<th>Medications for Long-Term Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: Mild intermittent</td>
<td>Brief exacerbations with symptoms no more often than twice a week. Nighttime symptoms no more than twice a week. Asymptomatic and normal PEFR between exacerbations. No emergent visits and no asthma-related absences from school. PEFR $\geq 80%$ of predicted with variability &lt; 20%.</td>
<td>No daily medications needed. Severe exacerbation may occur, separated by long periods of normal lung function and no symptoms. A course of systemic corticosteroids is recommended.</td>
</tr>
<tr>
<td>Step 2: Mild persistent</td>
<td>Exacerbations more than twice a week, but less than once a day. Nighttime symptoms more than twice a month. Exacerbations may affect activity and cause absences from school. PEFR $\geq 80%$ of predicted with variability of 20% to 30%.</td>
<td>Preferred treatment: Low-dose inhaled steroid. Alternate treatment: Cromolyn, leukotriene modifier, or nedocromil. OR Sustained-release theophylline to serum concentration of 5-15 mcg/mL.</td>
</tr>
<tr>
<td>Step 3: Moderate persistent</td>
<td>Daily symptoms of coughing and wheezing. Exacerbations at least twice a week that may last for days. Nighttime symptoms more than once per week. Exacerbations affect activity and several school absences occur. PEF or FEV$_1 &gt; 60%$ but &lt; 80% of predicted with variability &gt; 30%.</td>
<td>Preferred treatment: Low-to-medium-dose inhaled corticosteroid. Plus Long-acting $\beta_2$-agonists. Alternate treatment: Increase inhaled corticosteroids to within medium-dose range OR Low-dose inhaled steroid and either leukotriene modifier or theophylline. If needed (particularly in children and adolescents with recurring severe exacerbations) Preferred treatment: Increase inhaled corticosteroids within medium-dose range and add long-acting inhaled $\beta_2$-agonists. Alternative treatment: Increase inhaled corticosteroids within medium-dose range and add either leukotriene modifier or theophylline.</td>
</tr>
<tr>
<td>Step 4: Severe persistent</td>
<td>Continuous daytime symptoms, limited physical activity. Frequent exacerbations. Frequent nighttime symptoms. Limited physical activity. Hospitalizations are frequent with PICU admissions for severe exacerbations. PEF or FEV$_1 \leq 60%$ of predicted, with variability &gt; 30%.</td>
<td>Preferred treatment: High-dose inhaled corticosteroids. Plus Long-acting inhaled $\beta_2$-agonists. And if needed, Oral corticosteroids at 2 mg/kg/day (not to exceed 60 mg per day). Repeated efforts should be made to reduce systemic corticosteroids and maintain control with high-dose inhaled corticosteroids.</td>
</tr>
</tbody>
</table>

Quick relief
- Bronchodilator as needed for symptoms. Intensity of treatment will depend on severity of exacerbation.
  - Preferred treatment: Short-acting inhaled $\beta_2$-agonists by nebulizer, face mask, and space/holding chamber.
  - Alternative treatment: Oral $\beta_2$-agonist.
  
With viral respiratory infection
- Bronchodilator every 4-6 hours up to 24 hours (longer with physician counsel); in general, repeat no more than once every 6 weeks.
- Consider systemic corticosteroids if exacerbation is severe or patient has a history of previous severe exacerbations.
- Use of short-acting $\beta_2$-agonists > 2 times a week in intermittent asthma (daily or increasing use in persistent asthma) may indicate the need to initiate (increase) long-term control therapy.

<table>
<thead>
<tr>
<th>Rescue Medication</th>
<th>Action/Indication</th>
<th>Nursing Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beta2-agonists (short-acting)</strong>&lt;br&gt;Albuterol, metaproterenol, terbutaline, levalbuterol: inhalation, PO</td>
<td>Relax smooth muscle in airway, increase water content in bronchial mucus to promote muciliary clearance resulting in rapid bronchodilation within 5–10 minutes.&lt;br&gt;Drug of choice for acute therapy (metered-dose inhaler or nebulizer).</td>
<td>Use this rescue medication before inhaled steroid, wait 1–2 minutes between puffs, wait 15 minutes to give inhaled steroid. Child should hold breath 10 seconds after inspiring. Then rinse mouth and avoid swallowing medication. Use spacer.&lt;br&gt;Some side effects (tachycardia, nervousness, nausea and vomiting, headaches), but these are usually dose related.&lt;br&gt;Repetitive or excessive use can mask increasing airway inflammation and hyperresponsiveness and increase need for higher dosage to get same effect.&lt;br&gt;Use of more than 1 canister a month indicates inadequate control.</td>
</tr>
<tr>
<td><strong>Corticosteroids</strong>&lt;br&gt;Methylprednisolone: IV&lt;br&gt;Prednisone&lt;br&gt;Prednisolone: PO</td>
<td>Diminish airway inflammation and obstruction, enhance bronchodilating effect of Beta2-agonists.&lt;br&gt;Used for moderate to severe acute exacerbations when single Beta2-agonist dose given in emergency department does not resolve symptoms.</td>
<td>Not used as primary treatment.&lt;br&gt;Onset of action is 4–6 hours.&lt;br&gt;Short-term therapy for 3–10 days until symptoms resolve or child achieves 80% peak expiratory flow personal best.&lt;br&gt;Give with food.&lt;br&gt;Give daily oral dose in early morning to mimic normal peak corticosteroid blood level.&lt;br&gt;Assess for potential adverse effects of long-term therapy: decreased growth, unstable blood sugar, immunosuppression.</td>
</tr>
<tr>
<td><strong>Anticholinergic</strong>&lt;br&gt;Ipratropium: inhalation</td>
<td>Inhibits bronchoconstriction and decreases mucus production.&lt;br&gt;Provides additive effects to short-acting Beta2-agonists during acute exacerbation.</td>
<td>Not for primary treatment.&lt;br&gt;Side effects include increased wheezing, cough, nervousness, dry mouth, tachycardia, dizziness, headache, palpitations.&lt;br&gt;Avoid eye contact.</td>
</tr>
<tr>
<td><strong>Controller Medication</strong></td>
<td><strong>Action/Indication</strong></td>
<td><strong>Nursing Considerations</strong></td>
</tr>
<tr>
<td><strong>Beta2-agonists (long acting)</strong>&lt;br&gt;Salmeterol&lt;br&gt;Formoterol: inhalation</td>
<td>Relax smooth muscle in airway, used for nocturnal symptoms and prevention of exercise-induced bronchospasm.</td>
<td>Should not be used for acute asthma attack.&lt;br&gt;Should not be used in place of inhaled corticosteroids.&lt;br&gt;Caution against overdosage as side effects such as tachycardia, tremor, irritability, insomnia will last 8–12 hours.&lt;br&gt;Report use of more than 4 puffs a day as this may indicate need for stepped-up therapy.</td>
</tr>
<tr>
<td><strong>Methyloxanthines</strong>&lt;br&gt;Theophylline: PO&lt;br&gt;Aminophylline: IV</td>
<td>Relax muscle bundles that constrict airways; dilate airway; provide continuous airway relaxation; sustained release for prevention of nocturnal symptoms.&lt;br&gt;Aminophylline may be used for emergency adjunct therapy in ICU, but use is controversial.</td>
<td>Tablet should not be crushed or chewed.&lt;br&gt;Used for long-term control, so continuous administration is needed; works best when a specific amount is maintained in the bloodstream (therapeutic serum level, 10–20 mcg/L).&lt;br&gt;Requires serum level checks and dose adjustment.&lt;br&gt;Side effects include tachycardia, dysrhythmias, restlessness, tremors, seizures, insomnia, hypotension, severe headaches, vomiting, and diarrhea.</td>
</tr>
<tr>
<td><strong>Mast-Cell Inhibitors</strong>&lt;br&gt;Cromolyn sodium&lt;br&gt;Nedocromil: aerosol</td>
<td>Anti-inflammatory, inhibit early- and late-phase asthma response to allergens and exercise-induced bronchospasm; may be used for unavoidable allergen exposure.</td>
<td>Not used at time of symptom development or acute exacerbation.&lt;br&gt;Must be used up to 4 times a day to be effective.&lt;br&gt;Therapeutic response seen in 2 weeks, maximum benefit may not be seen for 4–6 weeks.&lt;br&gt;Adverse reactions include wheezing, bronchospasm, throat irritation, nasal congestion, anaphylaxis.</td>
</tr>
</tbody>
</table>

(continued)
Physiologic Assessment
Identify the child’s current respiratory status first by assessing the ABCs—airway, breathing, and circulation—to make sure the child’s condition is not life threatening. If the child

### COMPLEMENTARY CARE

**ALTERNATIVE ASTHMA TREATMENTS**

Parents of children from different cultures may have concerns about daily medication regimens. Some prefer to use folk medicines such as rubbing oils or camphor (Vicks VapoRub) preparations on the child’s chest. Learn about the family’s cultural beliefs and practices (Sydnor-Greenberg & Dokken, 2000). Up to 80% of Hispanic, African-American, and immigrant adolescents attending an inner-city high school reported the use of complementary therapies for the treatment of asthma that included rubs, teas (chamomile, ginger, wild root, and eucalyptus), prayer, and massage. There was no association between complementary therapy use and ethnicity or immigrant status. Nearly all adolescents indicated that they would repeat the use of the complementary therapy. It is important to ask about complementary therapy use by children and adolescents, with how it is used in conjunction with traditional therapy (Reznik, Ozuah, Franco et al., 2002).

### DEVELOPING CULTURAL COMPETENCE

**ASTHMA MANAGEMENT**

The number of asthma attacks among children under 18 years varies greatly by race and ethnicity. Non-Hispanic black children have the highest prevalence followed by non-Hispanic white children and Hispanic children (Centers for Disease Control, 2000). A recent study investigated these disparities and found a difference in preventive medications used for asthma. Findings revealed that differences in health beliefs, fear of steroids, or communication issues rather than financial barriers may play a role in the use of preventive asthma medications (Lieu, Lozano, Finkelstein et al., 2002). Learn about the family’s cultural beliefs and practices. Parents of children from different cultures may have concerns about daily medication regimens. Some prefer to use folk medicines such as rubbing oils or Vicks preparations on the child’s chest (Sydnor-Greenberg & Dokken, 2000). Individualizing care through education is a key to successful treatment. Education should be based on a “thorough assessment of the child’s and family’s resources, health care beliefs, access to health care services, and management styles” (Swartz, Cantey-Banasiak, & Meadows-Oliver, 2005, p. 78).

### NURSING MANAGEMENT

#### NURSING ASSESSMENT AND DIAGNOSIS

The nurse usually encounters the child and family in the emergency department or nursing unit. In these settings, acute care has become necessary because the child’s level of respiratory compromise cannot be managed at home.

### TABLE 47–13  
Medications Used to Treat Asthma—continued

<table>
<thead>
<tr>
<th>Controller Medication</th>
<th>Action/Indication</th>
<th>Nursing Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corticosteroids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beclomethasone</td>
<td>Anti-inflammatory, controls seasonal, allergic, and exercise-induced asthma.</td>
<td>■ Administer with spacer or holding chamber.</td>
</tr>
<tr>
<td>Budesonide</td>
<td>Effectively reduces mucosal edema in airways; usually combined with other asthma medications for control.</td>
<td>■ Rinse mouth following treatment to reduce chance of thrush and dysphonia.</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>First-line therapy in asthma management.</td>
<td>■ Monitor growth.</td>
</tr>
<tr>
<td>Triamcinolone: inhalation</td>
<td></td>
<td>■ Monitor for headache, gastrointestinal upset, dizziness, infection.</td>
</tr>
<tr>
<td><strong>Leukotriene Modifiers</strong></td>
<td>Reduces inflammation cascade responsible for airway inflammation.</td>
<td>■ Use exactly as prescribed.</td>
</tr>
<tr>
<td>Montelukast: PO</td>
<td>Improves lung function and diminishes symptoms and need for rescue medications.</td>
<td>■ Monitor growth.</td>
</tr>
<tr>
<td>Zafirlukast: PO</td>
<td>Adjunct to inhaled corticosteroids in moderate to severe asthma or substitute for inhaled corticosteroids in mild asthma.</td>
<td>■ Use exactly as prescribed.</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Series of injections that can reduce sensitivity to unavoidable allergens (e.g., environmental organisms—mold, pollen); gradual dose increase over time (buildup) increases the child’s tolerance to allergic substances; has been of help in some children.</td>
<td>■ Take as prescribed, do not withdraw abruptly.</td>
</tr>
<tr>
<td>Hyposensitization (allergy shots), subcutaneous</td>
<td></td>
<td>■ Use is controversial; some question about actual effect.</td>
</tr>
</tbody>
</table>

### CLINICAL PATHWAY

#### STAGES OF INPATIENT CARE FOR CHILDREN WITH SEVERE ASTHMA

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>CONTINUOUS NEBULIZER TREATMENTS</th>
<th>FREQUENT NEBULIZER TREATMENTS</th>
<th>TRANSITION TO DISCHARGE, NEBULIZER TREATMENTS EVERY 4–6 HR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcomes</strong></td>
<td>Patient will:</td>
<td>Patient will:</td>
<td>Patient is afebrile with stable vital signs.</td>
</tr>
<tr>
<td></td>
<td>■ Evidence stabilization of vital signs.</td>
<td>■ Evidence stable vital signs and be afebrile.</td>
<td>Patient exhibits a patent airway and unlabored respirations with activity.</td>
</tr>
<tr>
<td></td>
<td>■ Exhibit patent airway; experience resolution of acute respiratory distress.</td>
<td>■ Exhibit unlabored respirations and patent airway.</td>
<td>Patient's respiratory rate and status has returned to baseline.</td>
</tr>
<tr>
<td></td>
<td>■ Verbalize understanding and demonstrate cooperation with respiratory therapy.</td>
<td>■ Tolerate full diet,</td>
<td>Patient tolerates activity without evidence of respiratory distress, weakness, or exhaustion.</td>
</tr>
<tr>
<td></td>
<td>■ Have oral intake equal to fluid maintenance needs.</td>
<td>■ Tolerate age-appropriate activity without evidence of respiratory distress, weakness, or exhaustion.</td>
<td>Patient's mucus membranes are moist.</td>
</tr>
<tr>
<td></td>
<td>Family verbalizes feelings about illness.</td>
<td>■ Have moist mucous membranes.</td>
<td>Family verbalizes/demonstrates home care instructions, including strategies to reduce exposure to infectious illnesses and respiratory irritants.</td>
</tr>
<tr>
<td></td>
<td>Family displays effective coping.</td>
<td>■ Verbalize understanding and demonstrate cooperation with respiratory therapy.</td>
<td>Family exhibits willingness to make lifestyle changes and cope with effects of chronic illness.</td>
</tr>
<tr>
<td></td>
<td>Family understands plan of care for hospitalization.</td>
<td>Family exhibits beginning understanding of asthma and ongoing care and treatments.</td>
<td>Family demonstrates/verbalizes ability to cope with ongoing stressors.</td>
</tr>
<tr>
<td></td>
<td>Family verbalizes beginning understanding of asthma and ongoing care and treatments.</td>
<td></td>
<td>Family verbalizes beginning understanding of home care instruction including trigger agents, signs and symptoms of impending acute episode, and appropriate actions.</td>
</tr>
<tr>
<td><strong>Assessments</strong></td>
<td>Vital signs every 1–2 hr and pm.</td>
<td>Vital signs every 4 hr and pm.</td>
<td>Vital signs every 8 hr and pm.</td>
</tr>
<tr>
<td></td>
<td>Continuous pulse oximetry monitoring.</td>
<td>Assess respiratory status every 4 hr and pm. Monitor carefully for changes in respiratory rate, skin color, retractions, and/or flaring.</td>
<td>Pulse oximetry reading every 4 hr if patient is on oxygen.</td>
</tr>
<tr>
<td></td>
<td>Cardiorespiratory monitoring while on continuous nebulizer treatments.</td>
<td>Discontinue cardiorespiratory monitor.</td>
<td>Continue weaning oxygen if O2 saturation greater than or equal to 92%.</td>
</tr>
<tr>
<td></td>
<td>Potassium level 12 hr after on continuous nebulizer treatments, then every 12 hr.</td>
<td>Strict intake and output.</td>
<td>Assess respiratory status every 8 hr and pm.</td>
</tr>
<tr>
<td></td>
<td>Assess respiratory status every 1–2 hr and as necessary.</td>
<td>Urine specific gravity every 8 hr.</td>
<td>Monitor carefully for changes in respiratory rate, skin color, retractions, and/or flaring.</td>
</tr>
<tr>
<td></td>
<td>Monitor carefully for changes in respiratory rate, skin color, retractions, and/or flaring.</td>
<td>Humidification as ordered.</td>
<td>Provide quiet, restful environment.</td>
</tr>
<tr>
<td></td>
<td>Strict intake and output.</td>
<td>Position patient in semi-Fowler's or high Fowler's position.</td>
<td>Provide quiet, restful environment.</td>
</tr>
<tr>
<td></td>
<td>Urine specific gravity every 8 hr.</td>
<td>Continue pulse oximetry monitoring while on oxygen.</td>
<td>Deactivate nebulizer.</td>
</tr>
<tr>
<td></td>
<td>Humidification as ordered.</td>
<td>Wean oxygen, keeping O2 saturation at greater than or equal to 92%.</td>
<td>Discontinue weaning oxygen.</td>
</tr>
<tr>
<td></td>
<td>Position patient in semi-Fowler's or high Fowler's position.</td>
<td>Patient's mucous membranes are moist.</td>
<td>Discontinue nebulizer treatments.</td>
</tr>
<tr>
<td></td>
<td>Oxygen as ordered to maintain O2 saturation greater than or equal to 95%.</td>
<td>Patient tolerates activity without evidence of respiratory distress, weakness, or exhaustion.</td>
<td>Discontinue nebulizer treatments.</td>
</tr>
<tr>
<td></td>
<td>Provide quiet, restful environment.</td>
<td>Patient exhibits beginning understanding of asthma and ongoing care and treatments.</td>
<td>Discontinue nebulizer treatments.</td>
</tr>
<tr>
<td></td>
<td>Assess cognitive/developmental level.</td>
<td>Assess cognitive/developmental level.</td>
<td>Family verbalizes beginning understanding of asthma and ongoing care and treatments.</td>
</tr>
<tr>
<td><strong>Knowledge</strong></td>
<td>Initiate teaching regarding ongoing care, including procedures, treatments, and medications.</td>
<td>Reinforce earlier teaching about ongoing care.</td>
<td>Reinforce earlier teaching about ongoing care.</td>
</tr>
<tr>
<td></td>
<td>Initiate patient and family teaching about asthma, its treatments, trigger agents, avoidance of respiratory infections and irritants, and early signs and symptoms of infections.</td>
<td>Reinforce teaching about asthma and treatments.</td>
<td>Complete discharge teaching to include diet, follow-up care, signs and symptoms to report, follow-up physician visit, activity, and medications: name, purpose, dose, frequency, route, dietary interactions, and side effects.</td>
</tr>
<tr>
<td></td>
<td>Evaluate understanding of teaching.</td>
<td>Renew detailed teaching with family and patient about home care including medications, respiratory therapy, activity, trigger agents, avoidance of respiratory infections and irritants, early signs and symptoms of impending acute episode, and follow-up care.</td>
<td>Provide family/patient with written discharge instructions.</td>
</tr>
<tr>
<td></td>
<td>Provide information at developmental/cognitive level.</td>
<td>Evaluate understanding of teaching.</td>
<td>Refer unmet teaching needs to outpatient services.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Evaluate understanding of teaching.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Refer knowledge deficits to community resources.</td>
</tr>
</tbody>
</table>
is moving air or talking, assess the quality of breathing. Assess the respiratory rate. Inspect the chest for retractions to assess the severity of respiratory distress. Auscultate the lungs for the quality of breath sounds and for the presence or absence of wheezing. Observe the child’s color and assess the heart rate. Note whether a cough or stridor is present. Obtain oxygen saturation via pulse oximeter. Determine the severity of symptoms from the "Clinical Manifestations" table on page 1416. Only move on to other symptoms after finding no life-threatening respiratory distress.

Assess skin turgor, intake and output, and specific gravity. Because asthma can be a symptom of another illness, perform a head-to-toe assessment to identify other associated problems (Tables 47–1 and 47–7). (See Skills 9–1 to 9–22.)

Psychosocial Assessment
Assess the child’s anxiety. (See Table 47–9.) In an older child whose asthma was previously diagnosed, assess whether the child thinks this episode could have been
avoided if medication had been taken. Look for clues to hidden stress and self-blaming.

Common nursing diagnoses for the child experiencing an acute asthmatic episode include the following:

- **Ineffective Airway Clearance** related to airway compromise, copious mucus secretions, and coughing
- **Impaired Gas Exchange** related to airway obstruction, possible additional respiratory illness, and poor response to medication
- **Risk for Deficient Fluid Volume** related to difficulty in taking adequate fluids with respiratory distress
- **Anxiety/Fear (Child or Parents)** related to difficulty breathing and change in health status
- **Ineffective Therapeutic Regimen Management (Family)** related to inadequate education on daily management of a chronic disease

**PLANNING AND IMPLEMENTATION**

Pharmacologic and supportive therapies are used to reverse the airway obstruction and promote respiratory function. Nursing interventions center on maintaining airway patency, meeting fluid needs, promoting rest and stress reduction for the child and parents, supporting the family’s participation in care, and giving the family information that lets them manage the child’s disease.

**Maintain Airway Patency**

If the child is exhibiting breathing difficulty, give supplemental oxygen by nasal cannula or face mask. Humidified oxygen should be used to prevent drying and thickening of mucus secretions. Place the child in a sitting (semi-Fowler’s) or upright position to promote and ease respiratory effort. Evaluate the effectiveness of positioning and oxygen administration by pulse oximeter and by observing for improved respiratory status. (See Skill 14–1.)

The respiratory distress and need for supplemental oxygen can be stressful for parents and child alike (Figure 47–4). Encouraging the parents’ presence can be reassuring for the child. Keep the parents informed of procedures and results, and get their input when developing the treatment plan.

Many medications are given by the aerosol route (Figure 47–5). The advantages of aerosol are that the medication acts quickly, enabling the pulmonary blood vessels to absorb the inhaled medication, systemic effects are minimized, and the inhaled droplets provide the added benefit of moisture. Continuous aerosol treatments may be used for some children with severe exacerbations. Monitor the child for side effects. The frequency of vital sign assessment is related to the severity of symptoms. (See Skill 11–11.)

**Meet Fluid Needs**

Fluid therapy is often necessary to restore and maintain adequate fluid balance. Adequate hydration is essential to thin and break up trapped mucous plugs in the narrowed airways. An adequate oral intake may not be possible with the child’s compromised respiratory status. An intravenous infusion may be needed, and this route also may be used for administering medications and providing glucose. Overhydration must be avoided to prevent pulmonary edema in severe asthma attacks.

As respiratory difficulty diminishes, offer oral fluids slowly. Iced beverages precipitate bronchospasms in some...
Medications given by aerosol therapy allow children the freedom to play and entertain themselves.

children with asthma. It is safest to offer the asthmatic child room-temperature or slightly cooled fluids without ice. Determine the child’s fluid preferences and give choices where possible. Monitor intake and output and assess specific gravity frequently to evaluate the child’s hydration status. Involving parents in feeding can help gain the child’s cooperation in taking oral fluids.

**Promote Rest and Stress Reduction**

The child who has had an acute asthmatic episode is usually very tired when admitted to the nursing unit. Labored breathing and low oxygen status have left the child exhausted. Put the child in a quiet, private room if possible, but accessible for frequent monitoring to promote relaxation and rest. Avoid repeatedly disturbing the child by grouping tasks.

**Support Family Participation**

The parents may stay with the child, but may be exhausted after hours of their child’s respiratory distress. Give parents the option of assisting with the child’s treatments, rather than expecting them to do it in addition to comforting the child. Provide frequent updates about the child’s condition and encourage the parents to take breaks as needed.

Length of hospitalization depends on the child’s response to therapy. Any underlying or accompanying health problem, such as preexisting lung disease or pneumonia, can complicate and extend the child’s hospital stay. Communicate with the family of the hospitalized child at least once a day about the child’s condition.

**Discharge Planning and Home Care Teaching**

Parents need a thorough understanding of asthma—how to prevent attacks and provide treatment to maintain the child’s health and avoid unnecessary hospitalization. When possible, educate parents when they are rested but refer the child to a healthcare provider for more extensive education. Support of parents and the child should focus on helping them to understand and cope with the diagnosis and the need for daily management to promote near-normal respiratory function.

Discharge planning for the asthmatic child focuses on increasing the family’s knowledge about the disease, medication therapy, and the need for follow-up care according to guidelines of the National Asthma Education and Prevention Program. The required lifestyle changes may be difficult for the child and parents. The need to modify the home by removing a loved pet, for example, may create stress. When a family will not give up a pet, discuss the need to bathe the pet frequently to reduce animal dander. The nurse can facilitate discussion and clarification of ways to prevent asthma episodes. Teach the family how to measure and interpret peak expiratory flow readings (see Skill 11–12). Discuss rescue medications to manage asthma episodes, as well as controller medications for daily management. Reassure the family that most children with asthma can lead a normal life with some modifications.

**Nursing Care in the Community**

Nurses provide care to children with asthma in pediatricians’ offices, specialty asthma clinics, schools, and summer camps. Once the stress of the acute episode has passed, the community setting is ideal for ongoing coordinated education about asthma management. Help the parents and child to understand the diagnosis and the need for daily management to promote near-normal respiratory function while the child continues to grow and develop normally.

Key points to cover in asthma education include the following (Hayes, Djaferis, Gattasso et al., 2004):

- Explain that asthma is a chronic and progressive condition, but parents should expect that it can be controlled.
- Stress the need to follow the prescribed medication schedule, and discuss strategies to remember daily medications (specific time of day or daily event).
- Discuss possible adverse drug effects.
- Review proper use of metered dose inhaler, spacer, and peak flow meter.
Discuss keeping an asthma symptom diary. Explain that exercise is important for health, and asthma medications are given as needed, even in preparation for exercise. For a young school-age child, make sure the child’s teacher can help recognize respiratory distress and reduce the child’s fear of going to the nurse for rescue medications.

Environmental control is an important part of asthma management. When possible, pets should not be kept in the home (and never in the child’s bedroom). Active dust mite control should be attempted, but it is challenging as mites live in carpets, bedding, upholstered furniture, and clothes. To help control dust mites in the child’s bedroom, encase the pillow and mattress in plastic covers. Initiate cockroach control. Smoke from cigarettes, wood stoves, and fireplaces all have the potential to trigger an asthma attack.

Refer to “Nursing Care Plan: The Child with Asthma in the Community Setting” in Chapter 39 for additional information.

**EVALUATION**

Expected outcomes of nursing care include the following:

- The child recognizes early asthma symptoms and uses rescue medications, hydration, and relaxation breathing before severe respiratory distress occurs.
Identify parents’ knowledge about the condition:

1. Review why asthma occurs and assess parents’ understanding of the physiologic process. Ask:
   - What happens in your child’s lungs during an asthma attack?
   - What are the early warning signs of an asthma episode in your child?
   - What are your child’s symptoms and how does he or she respond to them? Does your child use the peak expiratory flow meter to evaluate symptoms? Is a diary maintained of the child’s symptoms?
2. Identify asthma triggers and assess parents’ understanding of how to prevent, avoid, or minimize their effect in a timely manner. Ask:
   - Do you know your child’s personal asthma triggers? Where do most episodes begin? (Suggest that the parents and child keep a notebook to track episodes so they can learn more about these triggers.)
   - What steps can you take or have you taken to minimize or eliminate your child’s exposure to indoor pollutants (quitting smoking, environmental control, etc.)?

Set up a schedule for parents and children to learn asthma management:
- Discuss when and where to seek emergency medical help.
- Discuss actions parents can take before seeking medical assistance.

Review parents’ understanding of medication therapy:
- Provide information about medications: name, type of drug, dose, method of administration, expected effect, possible side effects. Make sure they understand when controller and rescue medications should be used.
- Evaluate the child’s technique for the type of inhaler used as the techniques vary. Review the technique for use of the peak flow meter. See “Medication Administration—Growth and Development” on the Companion Website for growth and developmental issues regarding the use of inhalers.

Address associated issues:
- Storage and proper transport of medications.
- Financial considerations of medication cost and lifestyle changes.
- Notification of child’s school or teacher; arrangements for the child’s use of medications at school.
- Medical identification bracelet or medallion to facilitate assistance when the child is away from home.

The child and family implement a daily treatment plan for asthma and reduce the number of asthma episodes the child has.

The child with a serious asthma episode responds to oxygen, fluids, and medication therapy, avoiding hospital admission.

STATUS ASTHMATICUS

Status asthmaticus is unrelenting, severe respiratory distress and bronchospasm in an asthmatic child, which persists despite pharmacologic and supportive interventions. Without immediate intervention the child with status asthmaticus may progress to respiratory failure and die. The child is placed in an ICU and may require endotracheal intubation with assisted ventilation. The section on respiratory failure earlier in the chapter gives additional information on the nurse’s role in providing emergency respiratory care.

CYSTIC FIBROSIS

Cystic fibrosis (CF) is a common inherited autosomal recessive disorder of the exocrine glands that results in physiologic alterations in the respiratory, gastrointestinal, integumentary, musculoskeletal, and reproductive systems. The incidence of CF varies by race—1:3300 in whites, 1:17,000 in blacks, 1:8000 in Hispanics, and 1:32,000 in Asian Americans (McMullen & Bryson, 2004). Approximately 20,000 children and 10,000 adults have CF in the United States (Cystic Fibrosis Foundation, 2004) (Figure 47–6). The median life span for individuals with cystic fibrosis is 35 years (Cystic Fibrosis Foundation, 2005).

ETIOLOGY AND PATHOPHYSIOLOGY

A gene isolated on the long arm of chromosome 7 directs the function of the CF transmembrane conductance regulator (CFTR). With a defective CFTR, the exocrine and epithelial cells have defective chloride-ion transport and decreased water flows across cell membranes. This results in an abnormal accumulation of viscous, dehydrated mucus that affects the respiratory, gastrointestinal, and genitourinary systems. Inflammation and lung changes are present as early as 4 weeks of age. Ultimately, all body organs with mucous ducts become obstructed and damaged (McMullen & Bryson, 2004).
Cystic fibrosis is an inherited autosomal recessive disorder of the exocrine glands, so it is not uncommon to see siblings with it such as this brother and sister.

Because of the blocked pancreatic ducts and resulting pancreatic damage, the natural enzymes necessary to digest fats and proteins are not secreted, and malabsorption results in the majority of children by 1 year of age. In some children, the pancreas may stop producing insulin and the body may fail to use insulin normally, resulting in the development of diabetes mellitus.

The lungs are always filled with mucus, which the respiratory cilia cannot clear. This causes air to become trapped in the small airways, resulting in atelectasis (pulmonary collapse). Secondary respiratory infections occur because secretions provide an environment conducive to bacterial growth. Respiratory failure is the leading cause of mortality.

Nearly all males who have CF are sterile because of blockage or absence of the vas deferens. Females have difficulty conceiving because of chronic illness, and increased mucus secretions in the reproductive tract interfere with the passage of sperm (McMullen & Bryson, 2004).

Metabolic function is altered as a result of the imbalances created by excessive electrolyte loss through perspiration, saliva, and mucus secretion. The children are at risk for dehydration secondary to electrolyte imbalance. The “salty taste” of the skin is the result of sodium chloride that makes its way through skin pores to the skin surface.

### CLINICAL MANIFESTATIONS

The primary symptom of CF is the production of thick, sticky mucus. One of the earliest signs is meconium ileus, a small bowel obstruction in the newborn's first 48 hours of life. Stools of the child with cystic fibrosis characteristically are frothy (bulky and large quantity), smell foul, contain fat (are greasy), and float. Constipation is common and intestinal obstruction may occur in older children. Rectal prolapse, resulting from the large, bulky, difficult-to-pass stools, may occur.

Other signs and symptoms include a chronic moist, productive cough and frequent respiratory infections. Frontal headaches, facial tenderness, and purulent nasal discharge are signs of a chronic sinus infection. Nasal polyps are found in 10% of children with CF (McMullen & Bryson, 2004). Most children have difficulty maintaining and gaining weight despite a voracious appetite because of malabsorption and frequent infections. Infants and children may have a delayed bone age, short stature, and delayed onset of puberty. Clubbing of the tips of the fingers and toes occurs as the disease progresses (Figure 47–7).
Newborn screening using dried blood samples for immunoreactive trypsinogen is mandated in some states, and genetic testing of the child’s DNA is performed to confirm a positive test (Parad & Comeau, 2003). A sweat chloride test by pilocarpine iontophoresis is used to test children with classic symptoms or a positive family history (Mcmullen & Bryson, 2004). A sweat chloride concentration of 50 to 60 mEq/L is suspicious. If the chloride concentration is greater than 60 mEq/L, it is diagnostic with other signs. Two tests are performed to confirm the diagnosis (Figure 47–8). A spirometer is used on children older than 6 years to monitor pulmonary function. Sputum cultures are obtained to identify infectious organisms and antibiotic sensitivities.

Clinical therapy focuses on maintaining respiratory function, managing infection, promoting optimal nutrition and exercise, and preventing gastrointestinal blockage (Table 47–14). See Table 47–15 for medications used to treat CF. Newly diagnosed children will have no or minimal symptoms and near-normal lung function if aggressively treated. Pulmonary function declines 2% to 4% per year even with aggressive treatment (Varlotta, 1998).

Improvements in medical management and optimal nutrition have prolonged the lives of children with CF. However, new complications such as CF-related diabetes must be carefully coordinated along with the progression of the disease. Lung transplantation is occasionally performed, and approximately 50% of cases survive for the first 5 years (McMullen & Bryson, 2004). CF is ultimately terminal, however, because of the progressive multisystem changes and the difficulty of long-term infection management.

### TABLE 47–14 Clinical Therapy for Cystic Fibrosis

<table>
<thead>
<tr>
<th>Clinical Therapy</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory Therapy</td>
<td>Promotes maintenance of lung function</td>
</tr>
<tr>
<td>Exercise and physical fitness</td>
<td>In association with coughing and breathing techniques secretions move to bronchi from lung areas</td>
</tr>
<tr>
<td>Chest physiotherapy for all lung segments (bilateral percussion or vibration while the patient is in a position to promote sputum drainage)</td>
<td>Prevention of viral and some bacterial infections</td>
</tr>
<tr>
<td>Immunizations</td>
<td>Resolves pneumothorax</td>
</tr>
<tr>
<td>Chest tube drainage of air leaks</td>
<td>Repairs area of recurrent pneumothorax and prevents future episode in same location</td>
</tr>
<tr>
<td>Thoracoscopy to sew over ruptured alveoli</td>
<td>Reversal of respiratory failure</td>
</tr>
<tr>
<td>Lung transplantation</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal Tract Therapy</td>
<td>Gastroesophageal reflux worsens lung function; enteric coating of enzyme supplements is affected by high acid content in duodenum</td>
</tr>
<tr>
<td>Acid suppression preparation</td>
<td>Enema relieves meconium ileus in most infants; fluid lavage reduces distal intestinal obstruction</td>
</tr>
<tr>
<td>Hyperosmolar enemas, isotonic fluid lavage of the intestines orally or by nasogastric tube</td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td>Promotes essential nutrient balance for health, growth, and weight maintenance; nutritional counseling to support high-caloric intake; cultural-socioeconomic issues important</td>
</tr>
<tr>
<td>Well-balanced diet with 120–150% of RDA recommended calories and 200% of RDA recommended protein and moderate fat</td>
<td>Assists in digestion of nutrients and decreasing fat and bulk</td>
</tr>
<tr>
<td>Pancreatic enzyme supplements</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 47–15  Medications Used to Treat Cystic Fibrosis

<table>
<thead>
<tr>
<th>Medications</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerosol bronchodilators</td>
<td>Opens large and small airways; use before chest physiotherapy and with symptoms; few studies exist to demonstrate their effectiveness.</td>
</tr>
<tr>
<td>Aerosol DNAse</td>
<td>Loosens, liquefies, and thins pulmonary secretions; decreases risk of developing pulmonary infections requiring parenteral treatment in some patients (McMullen &amp; Bryson, 2004).</td>
</tr>
<tr>
<td>Corticosteroids and high-dose ibuprofen on alternate days</td>
<td>Anti-inflammatory agents: reduces inflammatory response to infection; alternate day use to decrease side effects of steroids; decreases progression of lung damage in preadolescents with mild disease.</td>
</tr>
<tr>
<td>Antibiotics (oral, IV, and inhalation)</td>
<td>Treats infections. Higher doses than normal and prolonged courses may be needed. Antibiotic selection should be based on culture sensitivities. Intermittent administration of tobramycin by inhalation improves pulmonary function.</td>
</tr>
<tr>
<td>Pancreatic enzyme supplements (Cotazym-S, Pancrease, Viokase)</td>
<td>Assists in digestion of nutrients decreasing fat and bulk; given prior to food ingestion, taken with meals and snacks.</td>
</tr>
<tr>
<td>Multivitamins and vitamin E in water-soluble form; vitamins A, D, and K given when deficient; iron supplementation</td>
<td>Cystic fibrosis interferes with vitamin production; supplements are required in water-soluble form for better absorption (vitamins A, D, E, and K are naturally fat soluble); iron deficiency results from malabsorption syndrome.</td>
</tr>
<tr>
<td>Ursodeoxycholate</td>
<td>May slow progression of hepatic lesion in CF. Given when patient has elevated liver enzymes or evidence of portal hypertension.</td>
</tr>
<tr>
<td>Lactulose</td>
<td>May abort early distal intestinal obstruction syndrome and prevent recurrences.</td>
</tr>
</tbody>
</table>

The Child with Alterations in Respiratory Function

NURSING MANAGEMENT

Care of the child with previously diagnosed CF is the focus of the following discussion.

NURSING ASSESSMENT AND DIAGNOSIS

Physiologic Assessment

Physical assessment of the child focuses on adequacy of respiratory function. The child with CF usually is admitted with symptoms of an upper respiratory infection. Obtain a set of baseline vital signs. Assess the child’s respiratory status. Auscultate the chest for breath sounds, crackles, and wheezes. Inquire about the frequency and character of the child’s cough and characteristics of sputum as changes may be related to a new infection. Note any cyanosis or clubbing of the extremities.

Evaluate the child’s growth, plotting the weight and height on a growth curve. Determine whether the child is maintaining an appropriate growth pattern or is malnourished. Inquire about the child’s appetite and dietary intake. How are nutritional supplements, pancreatic enzymes, and vitamins used?

Assess the child’s stooling pattern. Identify whether the child has problems with abdominal pain or bloating, and whether these problems can be related to eating, stooling, or other activities. Palpate the abdomen for liver size, fecal masses, and evidence of pain.

Psychosocial Assessment

The emotional stress of this chronic disease may not be readily apparent on admission, particularly if the child’s symptoms are mild and not imminently life threatening. Ongoing observation of the child’s and parents’ behavior helps direct nursing interventions throughout hospitalization (see Table 47–9). Parents may feel guilt as carriers of the disease. Siblings may also show signs of difficulty in dealing with the illness. Link the family to support groups. School-age children and adolescents often are embarrassed at being viewed as different from playmates and peers. Ask how the child and adolescent feel about the need for a special diet, medications, and limitations.

Ask parents how the child’s illness has affected day-to-day functioning, any potential conflicts with family activities, and how they have adapted to the child’s plan of care. Ask what the parents have told the child and siblings about the disease. What questions have the child and siblings asked about CF, and how have parents answered them? Has the child ever asked about his or her life expectancy? If not, what would parents say if asked?
Developmental Assessment

Growth and development may be altered by the chronic nature of the disease. Children with cystic fibrosis may be growth retarded. Compare the child’s height and weight to age norms and observe the adolescent for the appearance of secondary sex characteristics, which are often delayed.

Common nursing diagnoses for the child with cystic fibrosis include the following:

- **Ineffective Airway Clearance** related to thick mucus in lungs
- **Risk for Infection** related to the presence of mucous secretions conducive to bacterial growth
- **Imbalanced Nutrition: Less than Body Requirements** related to inability to digest nutrients
- **Parental Role Conflict** related to interruptions in family life due to the home care regimen and child’s frequent exacerbations

PLANNING AND IMPLEMENTATION

Nursing management involves supporting the child and family initially, when the diagnosis is made, during subsequent hospitalizations, and during visits to specialty and primary healthcare providers. The nurse’s role begins with implementing specific medical therapies and providing nursing care to meet the child’s physiologic and psychosocial needs. Respiratory therapy, medications, and diet must be coordinated to promote optimal body function. Psychosocial support and reinforcement of the child’s daily care needs are important in preparation for home care.

Children with cystic fibrosis require periodic hospitalization when a severe infection occurs or for a pulmonary and nutritional “tune-up.” The child is usually placed in a single room to reduce the spread of infectious organisms with standard precautions. Children with CF are not co-roomed to reduce the risk for transfer of the infectious organisms *Pseudomonas* and *Burkholderia cepacia* (Cystic Fibrosis Foundation, 2000). Respect the parents’ experiences as the child’s primary care provider and include them in the child’s routine care as much as possible. However, parents may view the hospital stay as a break from the rigorous daily pulmonary routine at home and need support in taking advantage of some “down” time. While the family is often proficient at providing physical care to the child, the nurse should take the opportunity to review basic and new information about respiratory care, medications, and nutrition.

Provide Respiratory Therapy

Chest physiotherapy is usually performed one to three times per day before meals to clear secretions from the lungs, as coughing may stimulate vomiting (Figure 47–9). Parents and other family members can learn to help

Postural drainage can be achieved by clapping with a cupped hand on the chest wall over the segment to be drained to create vibrations that are transmitted to the bronchi to dislodge secretions. **A**, if the obstruction is in the posterior apical segment of the lung, the nurse can do this with the child sitting up. **B**, if the obstruction is in the left posterior segment, the child should be lying on the right side. Several other positions can be used depending on the location of the obstruction. **C**, a high-frequency chest wall oscillation vest is another option for chest physiotherapy that the child can independently manage.
with these necessary treatments. Pulmonary care may involve aerosol treatments and antibiotics when indicated (see Table 47–11). (See Skill 14–25.)

**SKILLS**

**Administer Medications and Meet Nutritional Needs**

Antibiotics for acute exacerbation are provided by oral, inhalation, and intravenous routes. Because children with CF have an increased clearance of most antibiotics, they need higher doses and long treatment courses. Renal function needs to be monitored and serum antibiotic levels may be taken to ensure therapeutic dosing.

Digestive problems can be eased with pancreatic enzymes and dietary modification. Pancreatic enzyme supplements come in powder sprinkles and capsule form and are taken orally with all meals and large snacks. The amount needed is individualized based on the child’s nutritional needs and digestive response to these supplements. Families need to learn which foods if any to avoid that contribute to a child’s gastrointestinal problems. The goal is to achieve near-normal, well-formed stools and adequate weight gain.

Fat-soluble vitamins (A, D, E, and K) are not completely absorbed from food; therefore, they must be taken in water-soluble form. Multivitamins taken twice daily usually are sufficient to prevent deficiency. The diet should be well balanced, with an emphasis on high caloric value. Fats and salt are both necessary in the diet. Balanced with pancreatic enzyme supplements, moderate fat intake adds an important source of extra fuel. Respiratory complications cause additional energy expenditure, and some children require supplemental nasogastric or gastrostomy feedings to gain and maintain weight.

**Provide Psychosocial Support**

Help the parents and child learn what they must do to maintain health after discharge. Emotional support is essential because the diagnosis of this disorder creates anxiety and fear in both the parents and the child. They need assistance with emotional and psychosocial issues relating to discipline, body image (stooling and odor), frequent rehospitalization, the potential fatal nature of the illness, the child’s feeling of being different from friends, and overall financial, social, and family concerns. Because the disorder is inherited, families may have more than one child with cystic fibrosis. Parents may have unspoken feelings of anger and guilt, blaming themselves for their children’s condition.

**Discharge Planning and Home Care Teaching**

Review the family’s potential need for financial assistance due to the out-of-pocket costs for medications, supplies, equipment, and medical follow-up. Home care of the child with CF is expensive and can be draining on the family’s finances. If the family requires financial assistance, refer them to the appropriate social services.

Review the family’s potential need for financial assistance due to the out-of-pocket costs for medications, supplies, equipment, and medical follow-up. Home care of the child with CF is expensive and can be draining on the family’s finances. If the family requires financial assistance, refer them to the appropriate social services.

**NURSING PRACTICE**

Parents often have a difficult time getting the child with cystic fibrosis to eat the extra calories needed for optimal nutrition, setting the stage for a potential mealtime battleground. To be successful, parents need guidance about managing mealtime behaviors in addition to guidelines for preparing nutritional calorie-dense foods. Increase calorie intake by adding fats and high-calorie snacks between meals and before bed. Extra intervention may be needed when the child’s weight is 85% to 90% of ideal weight for height. Children with adequate nutrition have a longer life expectancy. See the Companion Website for links.

**Branchoal Hygiene Therapy**

Parents may encounter the child with cystic fibrosis following hospitalization for an acute exacerbation or provide hospice care. The Cystic Fibrosis Foundation is a source for family information. See the Companion Website for links.

**Nursing Care in the Community**

Nurses may encounter the child with cystic fibrosis in any of the following settings: clinics specializing in the disease, pediatricians’ offices, and schools. The primary goal is to keep the disease under control by promoting optimal nutrition and assisting the family to reduce the incidence of infection. Nurses may also provide home care to the child with cystic fibrosis following hospitalization for an acute exacerbation or provide hospice care.

**Assessment.** Perform the physical assessment as described for the hospitalized child. Obtain oxygen saturation and spirometry readings if changes in respiratory status are suspected. Observe the child’s physical appearance, noting overall body proportions and any changes characteristic of long-term CF. Assess hearing acuity on a regular basis if the antibiotic tobramycin is used as it has been associated with hearing loss.
Inquire about the family’s and child’s emotional and psychosocial responses to managing the illness. These issues are very important when the child is going through major developmental stages.

**Management.** Review the child’s use of bronchodilators and airway clearance techniques. To prevent a change in pulmonary status from progressing, short-term changes in care may be recommended. These may include intravenous and aerosol medications and antibiotics, an increase in the number of times chest physiotherapy is performed daily, and changes in dietary management. Help the family select the best time to fit the additional treatment into their schedule.

Malnutrition is a major problem for children with CF. Parents often need to plan meals and snacks for the young child to ensure that adequate calories are consumed. Arrange for a consultation with a nutritionist if the family would benefit from new strategies to help meet the child’s nutritional needs.

Children with CF lose more than normal amounts of salt in their sweat. This loss can become intensified during hot weather, strenuous exercise, and fever. Parents should allow the child to add extra salt to food and should permit some salty snacks (pretzels with salt, pickles, carbonated soda). During periods of increased sweating, the child should be encouraged to drink more fluids and increase salt intake. Teach parents to recognize early symptoms of salt depletion, including fatigue, weakness, abdominal pain, and vomiting, and to contact the child’s healthcare provider if these symptoms occur.

Adolescents with CF need special assistance in coping with their disorder, especially as survival into adulthood is common. Help them identify normal adolescent changes versus those related to CF. Adolescents must learn how to cope with the difference they know exists between themselves and peers. Provide information about potential infertility along with guidelines for safe sexual practices to reduce the risk for sexually transmitted infections. Females with CF may be able to conceive and should be offered contraception.

Gradual assumption of responsibility for daily disease management is necessary. Adherence with the daily disease management may be a problem during adolescence. Individualized planning to achieve their daily care regimen while enabling them to interact with peers and participate in school activities may be most helpful. Link adolescents to services to assist with planning appropriate educational and occupational goals for their future. Palliative care planning should be initiated as the disease progresses to respiratory failure.

**EVALUATION**

Expected outcomes of nursing care include the following:

- The child and family develop proficiency in providing the daily pulmonary care and reducing the incidence of respiratory infections.
- The child consumes adequate calories and pancreatic enzymes to support growth and to stay within desirable weight ranges.

**INJURIES OF THE RESPIRATORY SYSTEM**

Airway compromise after an unintentional injury can cause death if not managed quickly and effectively. Children are vulnerable to changes in respiratory function after injury. A child’s airway can become easily obstructed because of its small size. The airway may be obstructed by the tongue, small amounts of blood, mucus, or foreign debris, as well as swelling in the respiratory tract or adjacent neck tissue. If the child’s neck is flexed or hyperextended, the soft laryngeal cartilage may also compress and obstruct the airway.

**SMOKE-INHALATION INJURY**

Exposure to fire conditions sets up dramatic responses in the respiratory tract of children. In every age group, inhalation injury increases the child’s chance of death by 20%, and it also increases the likelihood that the child will develop pneumonia (Kim, 2001).

The severity of the smoke-inhalation injury is influenced by the type of material burned and whether the child was found in an open or closed space. The composition of materials determines how easily they ignite, how fast they burn, and how much heat they release. These factors influence the production of smoke and toxic gases. Smoke, a product of the burning process that is composed of gases and particles, is generated in varying volumes and density. The type and concentration of toxic gases, which are usually invisible, affect the severity of pulmonary damage. The duration of exposure to the smoke produced and any toxic gases contribute significantly to the child’s prognosis.

Exposure to extreme heat, common in house fires, leads to surface injury and upper airway damage. The upper airway normally removes heat from inhaled gases, sparing the lower airway from thermal damage. However, this action results in marked edema, placing the small child at particular risk for airway obstruction. Edema develops rapidly over a few hours and may lead to acute respiratory distress syndrome.

Carbon monoxide (CO) is a clear, colorless, odorless gas present in all fire conditions as the fire consumes oxygen. The CO molecule binds more firmly to hemoglobin than does oxygen. As a result, it replaces oxygen in circulation and rapidly produces hypoxia in the child. The longer
the exposure to CO, the greater the hypoxia. The brain receives inadequate oxygen, resulting in confusion. This accounts for the inability of fire victims to escape as confusion progresses to loss of consciousness. The process can be rapidly reversed, however, by timely administration of 100% oxygen (Schweich & Zempsky, 1999).

Damage to the lower airway most often results from chemicals or toxic gas inhalation. Soot is carried deep into the lungs, where it combines with water in the lungs to deposit acid-producing chemicals on the lung tissue. These acids burn the tissue, causing loss of cilia, loss of surfactant, and edema. Tissue destruction, edema, and disruption of gas exchange produce the initial insult to the lungs and potential airway obstruction. Days later, the damaged tissue sloughs off, obstructing the airways. Because the cilia that normally help remove debris have been destroyed, the lungs become a breeding ground for microorganisms. Pneumonia becomes a major health concern. The damaged alveoli heal by scar tissue formation. This can greatly reduce future lung function.

Burns of the face and neck, singed nasal hairs, soot around the mouth or nose, and hoarseness with stridor or voice change all indicate inhalation injury, even when the child initially has no respiratory distress. Edema develops around the mouth or nose, and hoarseness with stridor or voice change. A child with respiratory failure.

**NURSING MANAGEMENT**

Most children who survive smoke-inhalation injury are admitted for close observation, airway management, and ventilatory support, if indicated. Initial treatment is 100% humidified oxygen administered through a nonrebreather mask. Respiratory assessment and pulmonary therapy are usually required to reestablish adequate oxygenation and respiratory function. If respiratory distress develops, aggressive airway management with an endotracheal tube, mechanical ventilation, and monitoring are usually provided in an intensive care unit. Care is provided as described for the child with respiratory failure.

**BLUNT CHEST TRAUMA**

Blunt trauma is a common injury in children, especially associated with motor vehicle crashes (Pieper, 2000). Chest injuries may not be obvious and can be extremely difficult to evaluate.

Most children who die after sustaining severe blunt trauma were hypoxic because of poor airway and ventilatory control. A child’s elastic, pliable chest wall and thin abdominal muscles provide minimal protection to underlying organs. This elasticity often prevents rib fractures, but the energy from blunt trauma is transferred directly from an external force to the internal organs, often causing a pulmonary contusion or pneumothorax. A rib fracture in children under 12 years old indicates trauma of significant force.

**PULMONARY CONTUSION**

A pulmonary contusion is defined as bruising damage to the tissues of the lung. This causes bleeding into the alveoli, which may lead to capillary rupture in the air sacs. Pulmonary edema develops in the lower airways as blood and fluid from damaged tissues accumulate. Lower airway obstruction and atelectasis may result in impaired gas exchange, acute respiratory distress, and respiratory failure (Hazinski, 1999).

Pulmonary contusion occurs in the majority of children with nonpenetrating chest trauma. Initially the child may appear asymptomatic. Respiratory distress, along with fever, wheezing, hemoptyisis, and crackles, often develops over several hours. Careful observation is required during the first 12 hours after the injury to detect decreased perfusion related to ventilatory impairment.

**Nursing Management**

Nursing care centers on providing necessary physiologic support, such as oxygen therapy, positioning, positive pressure ventilation, oxygen, and comfort measures. The child’s level of consciousness is an excellent indicator of respiratory function. Agitation and lethargy can signal increasing hypoxia. When monitoring the status of a child who has a pulmonary contusion, do not rely on the child’s color as an indicator of adequate oxygenation. Cyanosis in children is often a late indicator of respiratory distress. Observe for hemoptyisis (fresh blood in the emesis), dyspnea, decreased breath sounds, wheezes, crackles, and a transient temperature elevation.

Inspect the thorax for symmetric chest wall movement and equal presence of breath sounds in both lungs. The child may initially appear well but requires careful and thorough monitoring to detect signs of deterioration. Children with significant injuries are cared for in the ICU. Some children require ventilator support as the pulmonary tissues heal.

**PNEUMOTHORAX**

A pneumothorax occurs when air enters the pleural space because of tears in the tracheobronchial tree, the esophagus, or the chest wall. If blood collects in the pleural space, it is called a hemothorax, and if blood and air collect, it is called a pneumohemothorax. A pneumothorax is one of the more common thoracic injuries in pediatric trauma patients.

There are three types of pneumothorax: open, closed, and tension. An open pneumothorax, sometimes referred to
A pneumothorax is air in the pleural space that causes a lung to collapse. Whether the air results from an open injury or from bursting of alveoli due to a blunt injury, it is important to focus on airway management and maintain lung inflation. Nursing management focuses on airway management and maintaining lung inflation. The child arrives on the nursing unit with a chest tube and drainage system in place. Continued close observation for respiratory distress is essential. Carefully monitor vital signs. Complications include hemothorax (if the thoracostomy and chest tube are improperly placed), lung tissue injury, and scarring from poor tube placement (especially if the tube is placed too near the breast in girls).

**Nursing Management**

As a sucking chest wound, results from any penetrating injury that exposes the pleural space to atmospheric pressure, thereby collapsing the lung. A sucking sound may be heard as the air moves through the opening on the chest wall.

A closed pneumothorax is sometimes caused by blunt chest trauma with no evidence of rib fracture (see “Pathophysiology Illustrated: Pneumothorax”). The chest may be compressed against a closed glottis, causing a sudden increase in pressure within the thoracic cavity. The child spontaneously holds his or her breath when the thorax is struck, accounting for the involuntary closing of the glottis. The pressure increase is transferred to the alveoli, causing them to burst. A single burst alveolus may be able to seal itself off, but with the destruction of many alveoli the lung collapses. Breath sounds are decreased or absent on the injured side, and the child is in respiratory distress. A thoracostomy is performed and a chest tube inserted (see Skill 14–15.)

A tension pneumothorax is a life-threatening emergency that results when the air leaks into the chest during inspiration but cannot escape during expiration. Internal pressure continues to build, compressing the chest contents and collapsing the lung. Venous return to the heart is impaired as the trachea, heart, vena cava, and esophagus are compressed toward the unaffected lung when the mediastinum shifts, leading to decreased cardiac output. Signs of tension pneumothorax include increasing respiratory distress, decreased breath sounds, and paradoxical breathing.
Critical Concept Review

LEARNING OBJECTIVES

Describe unique characteristics of the pediatric respiratory system anatomy and physiology and apply that information to the care of children with respiratory conditions.

List the different respiratory conditions and injuries that can cause respiratory distress in infants and children.

Assess the child’s respiratory signs and symptoms to distinguish between respiratory distress and respiratory failure and describe the appropriate nursing care for each level of severity.

CONCEPTS

1. A child’s airway is shorter and narrower than an adult’s:
   ■ Creates increased potential for obstruction.

2. Trachea is higher and at a different angle:
   ■ Causes increased risk for right mainstem obstruction.

3. Newborns are obligatory nose breathers:
   ■ Do not open mouth if nose is obstructed.

4. Newborn doesn’t have enough smooth muscle bundles to help trap airway invaders:
   ■ Increases possibility of upper respiratory infection.

5. Until age 6 the child uses the diaphragm for breathing:
   ■ Observe the abdomen to count respirations.

Respiratory conditions and injuries that can cause respiratory distress include:
1. Foreign body aspiration.
2. Obstructive sleep apnea.
3. Croup syndrome.
4. Epiglottitis.
5. Viral and bacterial respiratory infections.
6. Asthma.
7. Smoke inhalation.
8. Blunt chest trauma.

Signs of respiratory distress:
■ Tachypnea and tachycardia
■ Retractions
■ Nasal flaring
■ Inspiratory stridor
■ Pallor or mottled color
■ Labored breathing (dyspnea)

Signs of impending respiratory failure include:
■ Irritability, anxiety, mood changes
■ Lethargy or decreased responsiveness
■ Cyanosis
■ Wheezing
■ Nasal flaring
■ Retractions and accessory muscle use
■ Grunting

Nursing care includes:
1. Elevate head of the bed.
2. Monitor vital signs and level of responsiveness frequently for any changes.
4. Give oxygen as ordered.
5. Keep emergency equipment at the bedside to assist ventilations if necessary.
6. Keep child from crying, if possible.

(continued)
LEARNING OBJECTIVES

Develop a nursing care plan for a child with common acute respiratory conditions.

CONCEPTS

1. Maintain airway patency.
2. Frequently assess vital signs.
3. Allow child to assume position of comfort.
4. Meet fluid needs.
5. Promote rest and stress reduction for the child and parents.
6. Support the family’s participation in care.
7. Give the family members information that lets them learn to manage the child’s disease.

Develop a nursing care plan for the child with a chronic respiratory condition.

CRITICAL THINKING IN ACTION

View the Critical Thinking in Action video in Chapter 47 of the CD-ROM. Then, answer the questions that follow.

Adam and his mother have come to speak with you to discuss the plan of care for his asthma. Adam, who is 7 years old, has a history of episodic wheezing and nebulizer treatments, but was never was hospitalized for asthma until last week. He was treated in the emergency room and kept 2 days. He was treated in the emergency room and kept 2 days. His parents were educated about how to manage his mild persistent asthma. His mother has brought a doctor’s order along with Adam’s Albuterol MDI, his peak flow meter, spacer, and his asthma action plan. She tells you that he is also completing a dose of oral steroids and was placed on Singulair to help prevent the asthma. You discuss the peak flow meter, the guidelines, and what type of action to take as needed. Based on his height of 48 inches, his peak flow meter green zone is 160–128, his yellow zone is 128–80, and his red zone is 80 or below. If he is having problems, he is to take his Albuterol MDI with spacer, two puffs every 4–6 hours as needed.

1. What are some of the side effects associated with Adam’s Albuterol MDI?
2. What is the benefit to using a spacer on Adam’s Albuterol MDI?
3. What are the signs of respiratory distress to observe for with Adam?
4. Describe the pathophysiology with asthma and why Adam had an asthma attack.

MEDIA LINK

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■ NCLEX-RN® Review, case studies, and other interactive resources for this chapter can be found on the Companion Website at http://www.prenhall.com/london. Click on “Chapter 47” and select the activities for this chapter.

■ For animations, more NCLEX-RN® Review questions, and an audio glossary, access the accompanying CD-ROM in this textbook.
REFERENCES


