Objectives
1. Define the vocabulary terms listed
2. List the differences found in the respiratory system of a child, and identify potential risks
3. Develop a teaching plan for the parents of a newborn regarding SIDS prevention
4. Illustrate the anatomic difference in the ear canals of adults and children, and describe the significance of this difference along with nursing care for a child with otitis media
5. Summarize the nursing care for an infant with bronchiolitis
6. Explain the dietary needs for a child with cystic fibrosis
7. Outline the nursing observation and care necessary for a 2-year-old child with croup
8. Describe the nursing care for a child undergoing surgery for removal of tonsils and adenoids
9. Describe the nursing care of the child with asthma, including monitoring of respiratory status, respiratory treatments and medications, and the psychosocial implications of the condition
10. Discuss the important nursing care of a child with tuberculosis

Key Terms
Back to Sleep (p. 197)
hydrocarbons (p. 222)
laryngotracheobronchitis (la-RING-gó-TRÄ-ke-ó-brôn-Kís-tis: p. 207)
meconium ileus (p. 203)
pulmonary function test (PFT) (p. 196)
reactive airway disease (p. 214)
respiratory syncytial virus (RSV) (sí-ní-SÍSH-ál: p. 201)
retractions (p. 196)
stridor (p. 207)
thoracentesis (p. 223)
tripod position (p. 219)
tympanostomy tubes (p. 201)

RESPIRATORY SYSTEM
The respiratory system consists of the nose, pharynx, and larynx (upper respiratory tract) and the trachea, bronchi, and lungs (lower respiratory tract). The respiratory tract continually changes during the first 12 years of a child’s life. There are several anatomic differences that predispose children to respiratory difficulties (Box 11-1). This makes respiratory problems common during childhood. Most problems are mild and can be managed at home. Other conditions can be chronic and have an impact on the growth and development of the child. Respiratory distress and failure are the common factors for cardiac arrest in children. Respiratory diseases account for 25% of hospitalizations for children younger than 15 years of age. Pneumonia accounts for 31%, bronchiolitis and bronchitis for 25%, and asthma for 25% of the respiratory diseases (CDC, 2007).

Children with respiratory difficulties have common signs and symptoms that can progress to respiratory failure if not recognized. Assessment findings of the child’s respiratory system will vary depending on the age of the child. The nurse must recognize any change in the child’s breathing status. Signs and symptoms may include fever, anorexia, vomiting, diarrhea, abdominal pain, nasal blockage, nasal drainage, cough, sore throat, retractions, and abnormal respiratory sounds. Respiratory assessment should be comprehensive and frequent as the status can change rapidly. The assessment should include the guidelines shown in Box 11-2. Retractions can indicate respiratory distress. The severity of respiratory distress can be assessed using the depth and location of the retractions (Figure 11-1).

A variety of diagnostic tests can assist in monitoring respiratory function. Chest x-rays assist in identifying foreign objects or abnormalities in lung tissue. Pulse oximetry is a noninvasive method for measuring oxygen saturation. Pulmonary function test (PFT) and spirometry measure the vital and expiratory capacity.
that in the United States, SIDS kills about 3000 infants per year. In industrialized countries, SIDS is one of the leading causes of death in early infancy; the peak incidence is between 2 and 4 months of age. It is more common in low-birth weight babies, in boys, in families with crowded living conditions, and during the winter months. Autopsy may reveal slight respiratory infection or otitis media, petechiae over the pleura, and pulmonary edema. Two clinical features of the disease remain constant: (1) death occurs during sleep, and (2) the infant does not cry or make other sounds of distress. In some cases, the baby is found in one corner of the crib with blood-tinged froth coming from the nose.

Theories concerning the cause of SIDS are numerous. Although there appears to be an increased incidence among siblings, no genetic pattern has been determined. The risk for SIDS is increased in twins.

Many theories concerning cause (e.g., suffocation, aspiration allergy, and hormone deficiency) have been disproved. The exact cause is not known. Some researchers propose that crib death results from an interruption of some basic function in the central or autonomic nervous system that causes apnea. Carotid bodies located in the neck and involved in the control of breathing have been found to be abnormal in victims of SIDS. Current opinion holds that SIDS has more than one cause.

The death rate has continued to decrease, and the focus is on decreasing risk factors that contribute to SIDS. The Back to Sleep program has produced positive results. Co-sleeping has been identified as an increased risk of SIDS even if mothers do not smoke or if they breastfeed. Health care providers should encourage a separate crib or bassinet for sleeping.
Babies with infantile apnea (also called near-miss infants) and subsequent siblings of babies with SIDS are often monitored at home until they are past the age of danger. Monitors can be leased. Parents are provided with ongoing education and support during this period. Parents are taught cardiopulmonary resuscitation before being discharged.

In dealing with grieving parents after the death of their infant, the nurse must convey some important facts: that the baby died of a disease entity called SIDS, that this disease currently cannot be predicted or prevented, and that they are not responsible for the child’s death. Grieving parents need time to say good-bye to their child. They should be encouraged to hold and rock their infant, shed tears, and assist in burial preparations. This process, not common in the past, is conducive to the resolution of grief (see also Chapter 22). One mother who was denied this experience stated that 5 years later, while visiting a florist’s shop, she noticed a heart-shaped wreath intended for an infant. She unexpectedly burst into tears and wept.

Parents of a child who dies of SIDS experience a great deal of guilt and are catapulted into a totally unexpected bereavement, requiring numerous explanations to relatives and friends. Often needless blame has been placed on one parent by the other or by relatives. The family babysitter and physician may also be targets of attack. Emergency department personnel need to be especially sensitive and supportive during this crisis. There have been occurrences of SIDS for which parents have been charged with child abuse and have even been jailed because of lack of public knowledge about the disease.

Sudden infant death syndrome can occur in the hospital, and many nurses and physicians have personal experience of the suffering that losing a child to SIDS can cause. Group therapy with other parents of SIDS victims is recommended. Two nationally supported organizations are the Compassionate Friends, Inc., and the National Sudden Infant Death Syndrome Foundation. These groups have local chapters in most states.

**BRONCHOPULMONARY DYSPLASIA**

Bronchopulmonary dysplasia (BPD) is a chronic lung disease that occurs in newborns that are premature or have pulmonary disorders that require mechanical ventilator support with high positive pressure and oxygen. The lung tissue is immature and unable to withstand tissue damage resulting from the required oxygen supplement. The resulting fibrosis and alteration in lung compliance may last from several months to years. Improvements in treatment of low–birth weight preterm infants have increased the incidence of this disorder, and continue to be the primary issue for infants younger than 27 weeks of age (Belcastro, 2005).

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**Box 11-3  Evidence-Based Practice**

**Infant Sleeping Position**

**PROBLEM**

Infants discharged from NICU are more likely to be placed in a prone position.

**EVIDENCE**

Survey of 2300 mothers found 26% did not place 3-month-old in supine position; 42% reported bed sharing at 2 weeks and 27% at 12 months; higher incidence of prone sleeping position with African-American mothers.

Survey of nurses reported that most nurses felt for premature infants a nonsupine sleep position was best during hospitalization. 52% of NICU nurses discussed supine sleeping on discharge. 45% of nurses reported reflux and/or aspiration as reason for nonsupine position (Carrie, 2009).

**IMPLICATIONS**

Back to Sleep program (BTS) has shown to decrease the incidence of SIDS. Nurses have the opportunity to model and educate families about appropriate sleeping position.

**CRITICAL THINKING**

Identify practices that would increase the use of supine sleep position for newborns and infants.

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**Guidelines for Prevention of SIDS**

- Always place infant on his or her back to sleep, and do **NOT** use side-lying position (see Box 11-3).
- Use a firm sleep surface with a safety-approved crib mattress.
- Keep soft objects and loose bedding out of infant’s sleep area.
- Avoid overheating, keeping head uncovered.
- Do not smoke during pregnancy or near babies.
- Avoid co-sleeping, but keep infant’s sleep area close. Keep infant’s bedroom door open.
- Avoid home respiratory or cardiac monitors used to reduce SIDS risk.
- Avoid devices that claim to maintain sleep position to reduce SIDS.
- Consider offering a clean, dry pacifier (controversial).
- Provide tummy time during awake periods.
- Stress that all care providers for infant follow the guidelines (AAP, 2005).

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**Cultural Considerations**

African-American infants are twice as likely to be put to sleep on their stomachs, and parents may need more instruction (Carrier, 2009).
Signs and Symptoms

The symptoms of BPD are directly related to the pathophysiology of the disease. Tachypnea, dyspnea, and wheezing can be a result of airway obstruction and increased airway resistance. Increased work of breathing can cause retractions and use of accessory muscles. The infants may display activity intolerance during feedings. They may be irritable and difficult to comfort. Cyanosis may develop during crying spells. Infants who needed intubation for a long period of time may have subglottic stenosis and inspiratory stridor develop. All of the symptoms can be associated with the chronic hypoxia state. The diagnosis is made on the basis of abnormal radiographic findings, signs of respiratory distress, oxygen dependency after 28 days of age, and a history of required mechanical ventilation during the first week of life.

Treatment and Nursing Care

The treatment for infants with BPD is to provide adequate oxygenation and prevent progression of the disease process. Treatment includes oxygen, drug therapy, and nutritional support. Surfactant continues to be included in the course of medical treatment (Akins and Diehl-Jones, 2009). Infants may continue to need oxygen after hospital discharge. These infants do not tolerate excessive or even normal amounts of fluids. They may have problems develop with accumulation of fluids in the lungs that require the use of diuretics. The use of these drugs requires the monitoring of electrolytes and edema. Oral electrolyte supplements may be given. Bronchodilators (albuterol) and steroids may promote improved lung function. These infants are at risk for respiratory infections and should be given RSV-immune globulin (RespiGam) or palivizumab (Synagis) during the RSV season.

Infants with BPD are at high risk for growth failure, and nutrition is an important issue (VanRiper, 2010). They have higher metabolic needs, and providing adequate nutrition without causing respiratory distress can be difficult. Nursing care should be organized to provide periods of rest. Small, frequent feedings and nutritional supplements may be used. The environment should include measures to decrease stimulation.

OTITIS MEDIA

Otitis media (ot, ear; itis, inflammation of; media, middle) is an inflammation of the middle ear. The middle ear is a tiny cavity in the temporal bone. Its entrance is guarded by the sensitive tympanic membrane, or eardrum, which transmits sound waves.
through the oval window to the inner ear. The inner ear contains the organs of hearing and balance. The middle ear opens into air spaces, or sinuses, in the mastoid process of the temporal bone. It is also connected to the throat by a channel called the eustachian tube. These structures—the mastoid sinuses, the middle ear, and the eustachian tube—are lined with mucous membranes. As a result, an infection of the throat can easily spread to the middle ear and mastoid. The eustachian tube also protects the middle ear from nasopharyngeal secretions and provides drainage of middle ear secretions into the nasopharynx and equalizes air pressure between the middle ear and the outside atmosphere. These protective functions are diminished when the tubes are blocked. Unequalized air within the ear creates a negative pressure that allows organisms to be swept up into the tube if it opens.

Otitis media may be the result of an upper respiratory tract infection, caused by a variety of organisms. The most common cause of these infections is viral. Bacteria cause the rest of otitis media cases. Of the bacterial cases, 40% to 50% are caused by Streptococcus pneumoniae, which is increasingly demonstrating resistance to penicillin. Other common bacteria that cause otitis media are Haemophilus influenzae and Moraxella catarrhalis. With the use of H. influenzae type b vaccine (Hib) as a routine immunization, the number of cases of otitis media caused by this organism has decreased. The addition of the seven-valent S. pneumoniae conjugate vaccine to the immunization schedule should also decrease the incidence rate of otitis media caused by this organism (Morris, 2009). Infants are more prone to ear infections because the eustachian tube is shorter, wider, and straighter than in older children and adults. Because babies lie flat for long periods, microorganisms have easy access from the eustachian tube to the middle ear. This is thought by some investigators to be a contributing factor.

There are two types of otitis media. The acute disease is suppurative or purulent otitis media (AOM). It is most commonly caused by S. pneumoniae and H. influenzae. The second type is called serous or nonsuppurative otitis media with effusion (OME). The cause is unknown, but it often occurs after an acute episode. OME is the most common cause of hearing loss and hearing impairment in children.

Signs and Symptoms
The symptoms of acute otitis media (AOM) are pain in the ear (often severe), irritability, and interference with hearing. Sucking or chewing has a tendency to increase the pain. Fever, which may run as high as 40° C (104° F), headache, and vomiting may also accompany the illness as may diarrhea. The nurse may suspect an earache in the infant who rubs the ear frequently or pulls at it. The infant may also roll the head from side to side and cry piercingly. The older child can point to the place that is tender. OME is the result of chronic otitis media. Children may be asymptomatic but may report a feeling of fullness or popping in the ears.

If an abscess forms, the eardrum may rupture as a result and pus may drain from the ear. When this happens, the pressure is relieved and the child is more comfortable.

Complications of an ear infection include hearing loss, mastoiditis, chronic otitis media, and meningitis. These complications are rare with modern treatment. Prevention lies in the prompt treatment of respiratory infections or infected tonsils and adenoids.

Treatment and Nursing Care
The professional who examines the ears first observes their appearance and general hygiene. The lymph nodes about the ear are observed for swelling or tenderness. The child’s head is adequately stabilized to prevent injury to the ear canal from sudden, unexpected movement. Excess cerumen or wax in the ear, which may obstruct visibility, is carefully removed. The professional who examines the ears first observes their appearance and general hygiene. The lymph nodes about the ear are observed for swelling or tenderness. The child’s head is adequately stabilized to prevent injury to the ear canal from sudden, unexpected movement. Excess cerumen or wax in the ear, which may obstruct visibility, is carefully removed. The examiner ensures that no foreign bodies are lodged in the outer canal before inserting the otoscope. To straighten the canal and improve viewing, the ear is pulled down and back in infants and small children. The ear is pulled up and back in older children and adults. The physician may also perform a pneumatic otoscopic examination. The ear speculum is used to seal the ear canal, and air is expressed into the canal. The movement or lack of movement of the tympanic membrane is indicative of the degree of fluid behind the membrane. This examination has proven useful in determining the degree of the condition.

New treatment guidelines were released in 2004 by the American Academy of Pediatrics (AAP) (Box 11-4). Treatment included an observation option, pain management, and antimicrobial treatment. Development of resistant strains of bacteria and misuse of antimicrobials assisted in the development of new guidelines. When antimicrobials are used, amoxicillin remains the

<table>
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<tr>
<th>Box 11-4</th>
<th>Acute Otitis Media Guidelines</th>
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<tr>
<td>• Diagnosis of AOM by history, signs, and symptoms</td>
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<tr>
<td>• Assessment of pain and pain management for first 24 to 36 hours</td>
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<tr>
<td>• Optional treatment course of observation for 48 to 72 hours without antibacterial treatment; if child fails to respond within 48 to 72 hours, antibacterial therapy should be started</td>
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<tr>
<td>• Treatment using antibacterial agent; high-dose amoxicillin is recommended</td>
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<tr>
<td>• Encouragement of prevention by reducing risk factors Insufficient evidence to recommend use of complementary and alternative medicine (CAM) (AAP, 2004)</td>
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drug of choice, but recurrent infections may require other antimicrobials. Parents are taught to give the entire dose of the antimicrobial even though the child may appear well. Parents will need to understand the new course of treatment using the guidelines and their role in the management of AOM.

Pain control may be needed for the child with AOM. Pain control is achieved using acetaminophen or ibuprofen as prescribed. Antihistamines and decongestants are not effective and may have side effects. Eardrops (Auralgan) may be prescribed to control pain. Warm or cold compresses may be applied to the ear. The child can be placed on the affected side with the ear on top of a hot water bottle (temperature of the water 115° F, or 46° C) or on a heating pad on the low setting. Children should be placed upright to decrease pain. If the ear is draining, the outer canal can be cleaned with sterile water or hydrogen peroxide. Parents should be instructed not to use cotton swabs in the ears.

Nurses need to be aware that environmental factors have been identified that can contribute to the risk for ear infections. Daycare outside the home, parental smoking, and pacifier use has been shown to increase the risk for recurrent otitis media. Breastfeeding for at least 6 months has reduced the risk for AOM. These factors should be discussed with parents.

### Health Promotion

**Risks for Otitis Media That Need to Be Discussed with Parents**

- Parental smoking
- Excessive pacifier use
- Daycare outside the home

### Community Considerations

Parents may wish to use alternative therapies in the care of their child. Many of the herbal remedies available have not been evaluated for use in the pediatric population. These remedies are not regulated by the U.S. Food and Drug Administration (FDA) and thus may not be as labeled. Homeopathy remedies are regulated. The AAP has not made any recommendation because of insufficient evidence of effectiveness.

### Nursing Brief

Children should be fed in an upright position and should not be put to bed with a bottle.

For children with recurrent AOM or chronic OME, **tympanostomy tubes** may be effective. The physician performs the procedure by completing a **myringotomy** (myringo, eardrum; atomy, incision) and inserts a tiny tube into the eardrum. These tubes require surgical placement and special care by the parents. Eventually, the tubes fall out spontaneously.

### BRONCHIOLITIS

Bronchiolitis is an inflammation of the small airways. It occurs most often during late autumn through late spring and in children younger than 2 years of age. Bronchiolitis is usually caused by a viral infection. The most common causative organism is the **respiratory syncytial virus (RSV)**. Children are usually exposed through other family members who have symptoms of an upper respiratory tract infection. Children who are at risk for respiratory distress have chronic lung diseases such as bronchopulmonary dysplasia (BPD) or cystic fibrosis (CF).

Inflammation of the bronchioles is associated with obstruction that is caused by edema and accumulation of mucus. There may be partial or complete obstruction. The alveoli are usually not affected. Normal gas exchange in the lung is affected. This leads to hypoxemia.

### Signs and Symptoms

The infant first shows signs of a mild upper respiratory infection with rhinorrhea, sneezing, cough, and a low-grade fever. The infant’s appetite may be affected. Respiratory distress increases, and rapid breathing and wheezing develop. Bottle feeding may be difficult because of the rapid respiratory rate interfering with sucking and swallowing. As the disease progresses, nasal flaring, retractions, tachypnea (60 to 70 per minute), and cyanosis may occur. Breath sounds may be diminished if the bronchioles are severely obstructed.

### Treatment

Mild cases of bronchiolitis can be managed at home. Treatment at home includes increasing the intake of fluids and increasing the humidity in the air. Also useful are antipyretics to control fever. The parents or caregiver should be instructed to bring the child back for reevaluation if any signs of increased respiratory distress occur or if the child’s condition worsens.

Indications for hospitalization include an infant younger than 6 months of age, sleeping respiratory rates of 50 to 60 per minute or higher, hypoxemia, apnea, or the inability to tolerate oral feeding.

When the child is hospitalized, intravenous fluids are started to hydrate the child and thin the secretions. The child is placed in an atmosphere of humidified oxygen (mist tent, croupette, or nasal cannula/mask). The goal is to keep oxygen levels at 92% or better with a pulse oximeter. With severe bronchiolitis, the physician may use a bronchodilator and a corticosteroid, but these remain controversial (Zorc, 2010). Antimicrobials may also be used for small or severely ill infants because these infants may be susceptible to a secondary bacterial infection. Fever is controlled with...
antipyretics. A laboratory study of a nasopharyngeal washing should be done to determine whether the causative organism is RSV. As a precautionary measure for the safety and concern of other children, the infant is placed in contact isolation until RSV has been ruled out.

When the causative organism is RSV, no medications can effectively treat the disease. Ribavirin, antimicrobials, antihistamines, and oral decongestants have been identified as being ineffective for treatment (Zorc, 2010). Medical attention has recently focused on active and passive immunizations. RSV-immune globulin (RespiGam) and palivizumab (Synagis) have been approved for use with children at high risk. Palivizumab may be preferred because of ease of administration (intramuscular); lack of interference with mumps, measles, and rubella (MMR) vaccine and varicella vaccine; and lack of complications associated with intravenous immune globulin (RespiGam). Monthly administration during RSV season (October to May) is recommended (AAP, 2009).

**Nursing Care**

Nursing diagnoses for the infant with bronchiolitis include the following:

- Ineffective airway clearance, related to thick mucus
- Impaired gas exchange, related to edema and mucus of the bronchioles
- Deficient fluid volume, related to insensible fluid loss from tachypnea and decreased intake
- Anxiety, related to unfamiliar environment, respiratory distress, and placement in croupette
- Knowledge deficit, related to disease process and treatment

The child with bronchiolitis is monitored closely for signs and symptoms of increasing respiratory distress. Breath sounds, skin color, depth and rate of respiration, and vital signs are assessed. Changes in alertness and increased anxiety can be signs of impending distress. Continuous or intermittent pulse oximetry may be used to monitor the infant’s oxygen level.

**Nursing Brief**

Infants with a respiratory rate of 60 breaths per minute should have nothing by mouth.

Intravenous fluids are monitored in the acutely ill child. As the child improves, oral fluids are increased and frequent small meals are offered. The child is on intake and output recording, and daily weights are taken. The fontanel and the child’s skin turgor are also assessed as indicators of hydration status.

Formula-fed infants may have thickened feeding to improve swallowing dysfunction and to prevent aspiration. Breastfed infants should have more frequent feeding with shorter times. This assists in decreasing the workload of the infant and conserves energy. Nasal secretions should be removed with a bulb syringe before feedings (Allen, 2006).

The child in a mist tent should have the gown and linens changed if they become damp. Also, moisture buildup should be removed from the tubing and the sides of the tent (see Chapter 3 for detailed care of the child in a mist tent). For home care, cold air humidifiers can be used but must be cleaned properly to prevent bacteria or fungal growth.

As always, parents are encouraged to stay with the child. This may be even more important because the child may already be anxious because of respiratory distress. Parents should understand the importance of the child staying in the tent. They should be included in the care and diversional activities for the child.

Preventing the spread of infection is also important. If an infant has RSV, then contact isolation is recommended. RSV is primarily spread by large droplets and fomites. RSV can survive on hands for almost an hour and on hard surfaces up to 24 hours. Health care–associated infections (HAIs) or nosocomial infections can be a serious nursing issue. Hand hygiene is extremely important in all issues of infection. All caregivers, including parents, need to know and apply measures to prevent the spread of infection.

Support of the parents is significant. Most of the infants who are in severe or critical condition are usually young infants or those who have an underlying disease. Their parents may lack confidence when it comes to the care of the infant and need to be supported and reassured in their actions. It can be frightening for them to see their infant so ill. If the infant is admitted to a critical care area, the support of the parents is crucial. Explanations should be given in terms the parents can understand. The family needs information from the physician or the nurse concerning the infant’s condition, medications, treatments, and procedures. Plans for all of these issues and discharge information can aid the parents in coping with the situation. Family, friends, and clergy can be a great support for the parents.

**CYSTIC FIBROSIS**

Cystic fibrosis (CF) is a genetic disorder that results in a multisystem disease involving the cell membrane and the electrolyte and water system of the cell. This disease affects many parts of the body but particularly the lungs and pancreas. It occurs in about 1 in 3000 live births. CF is an inherited congenital disorder. The condition is believed to be inherited as a [Mendelian recessive trait](#) from both parents. The parents, who are carriers of this disease, do not show any symptoms. CF disease results when the two genes for the disease combine during conception. CF affects both genders equally. The survival rate of the children has increased,
20% of children who are born with CF. An overview of the manifestations of CF is shown in Figure 11-3.

**Lung Involvement.** Cystic fibrosis is considered the most serious lung problem in children in the United States. The air passages of the lungs become clogged with mucus. There is widespread obstruction of the bronchioles. It is hard for the child to breathe; expiration is especially difficult. More and more air becomes trapped in the lungs (obstructive emphysema), and small areas of collapse (atelectasis) may occur. Eventually, the chest assumes a barrel shape, with increased diameter across the front and back. The right ventricle of the heart, which supplies the lungs, may become strained and enlarged. Clubbing of the fingers and toes, indicating a chronic lack of oxygen, may be present. Staphylococcus and Pseudomonas infections can easily occur in the lungs, which provide a suitable medium for these organisms to grow. This causes more thickening of the abnormal secretions, irritates and damages lung tissues, and further increases lung obstruction.

The time of onset of this disease varies. Symptoms may appear weeks, months, or years after birth. In general, the earlier the onset of the disease symptoms, the more severe course of the disease. Symptoms range from mild to severe. Any or all symptoms may be present in varying degrees of severity in one and many are living into adulthood. Better antimicrobial control of pulmonary infection both at home and during hospitalization and increased numbers of CF centers have contributed to this success.

The gene associated with CF was identified in 1989, and it is now possible to identify healthy individuals who carry the trait. Chromosome 7 is the location of the gene responsible for CF. Sodium and chloride at the cell membrane are controlled by this gene. With a defect in the CF transmembrane regulator (CFTR) protein, secretions become thick and pasty. There are many possible mutations, which helps to explain the various degrees of involvement of the systems: respiratory and GI.

With the ability to identify the CF gene, diagnosis can be assisted with genetic analysis. Caution is noted because of the possibilities of false-positive and false-negative results. Genetic analysis can be used in conjunction with other diagnostic criteria such as the sweat test. New aggressive approaches in treatment have resulted in increasing the life expectancy from less than 10 years to 40 years.

**Signs and Symptoms**

The major symptoms of CF are manifested in the respiratory tract and the GI tract. The first symptom may be seen in the newborn infant who has a meconium ileus. This condition is seen in approximately 10% to 20% of children who are born with CF. An overview of the manifestations of CF is shown in Figure 11-3.
individual. A chronic cough develops that may produce vomiting. Dyspnea, wheezing, and cyanosis may occur. The child is irritable and tires easily. Gradually, there is a change in physical appearance. Chest radiographs reveal widespread infection. Evidence of obstructive emphysema, atelectasis, and fibrosis of lung tissue may also be present. The prognosis for survival depends on the extent of lung damage. However, this is only part of the picture because CF also affects the pancreas and sweat glands.

**Pancreatic Involvement.** The pancreas lies behind the stomach. Some of its cells secrete pancreatic enzymes that drain from the pancreatic duct into the duodenum at the same area in which bile enters. Changes occurring in the pancreas are the result of obstruction by thickened secretions that block the flow of pancreatic digestive enzymes. Consequently, foodstuffs, particularly fats and proteins, are not properly used by the body.

In infants, the stools may be loose. Gradually, because of impaired digestion and food absorption, the feces of the child become large, fatty, and foul-smelling. They are usually light in color. In spite of having a good appetite, the infant does not gain weight and may look undernourished. The abdomen becomes distended, and the buttocks and thighs atrophy as fat disappears from the main deposit sites. Laboratory test results show a deficiency in pancreatic enzymes (trypsin, lipase, and amylase).

An oral pancreatic extract such as Pancrease is given to the child with each meal and snack to replace the pancreatic enzymes the child’s body cannot produce. This medication is considered specific for the disease because it aids in the digestion and absorption of food, thus improving the condition of the stools. If the child is ill and not eating, the medication is withheld.

A presenting condition known as meconium ileus develops after birth when the intestine of the newborn becomes obstructed with abnormally thick meconium while in utero. This is caused by the absence of pancreatic enzymes that normally digest proteins in the meconium. The abnormal, puttylike stool sticks to the walls of the intestine, causing blockage. Vomiting, abdominal distention, and absence of stools lead to the suspicion of intestinal obstruction. Radiographs confirm the diagnosis. The condition is treated surgically. The death rate is high, but the prognosis is more favorable when the obstruction is detected early. Most infants who survive manifest CF. Fortunately, meconium ileus is rare because the pancreatic enzyme deficiency is seldom complete. Nevertheless, the nurse assigned to the nursery must constantly be on guard for suspicious symptoms.

**Sweat Glands.** The sweat, tears, and saliva of the child with CF become abnormally salty from an increase in sodium and chloride levels. There is also an increase in the potassium level of sweat glands. The normal amount of chloride in sweat is 1 to 60 mEq/L. Higher concentrations are considered specific for the disease. The analysis of sweat is a major aid in the diagnosis of the condition. The sweat test, with pilocarpine iontophoresis, is the best diagnostic study. A dilute solution of pilocarpine is applied to the arm, and a weak electrical current is used to stimulate sweating. A positive test should be repeated for confirmation. Because large amounts of salt are lost through perspiration, the child must be observed for heat prostration. Liberal amounts of salt should be given with food, and extra fluids and salt should be provided during hot weather. Infants do not have a lot of sweat; therefore obtaining enough sweat for an accurate test may be difficult. Mothers often report that when they kiss their infants they taste salty.

**Complications**

Cystic fibrosis is often responsible for rectal prolapse in infants and children. This is partly from poor muscle tone in the rectal area and excessive leanness of the buttocks of the child.

As the disease progresses, the liver may become hard, nodular, and enlarged. There may be edema of the extremities. The retina of the eye may hemorrhage, there may be damage to the eye from swelling, and inflammation in part of the optic nerve may occur. Cor pulmonale (cor, heart; pulmon, lung), heart strain from improper lung function, is frequently a cause of death. Osteoporosis (osto, bone, pore; osis, disease) may occur. When it is caused by CF, the bones become porous because of poor utilization of fat-soluble vitamin D, which is necessary for proper calcium metabolism. There is a deficiency in vitamin A also because the child is unable to absorb the fats from which this vitamin is obtained.

With the extended life expectancy, about 20% or higher of the children develop hyperglycemia and cystic fibrosis-related diabetes (CFRD). Blood sugar control becomes an important objective. With malabsorption and pancreatic insufficiency issues, control becomes challenging. Oral hypoglycemia drugs and insulin may be used. As they become adults, these children can develop the vascular problems seen with the long-term effects of diabetes.

**Treatment and Nursing Care**

Cystic fibrosis is a chronic condition and must be monitored and maintained daily. The family providers of care need support, as does the child. The care in a regional CF center, where all disciplines are located in one facility, can be extremely helpful because it allows the family to go to one location rather than traveling to several different clinics for care. The CF team can work with the family and the
primary care physician to meet the needs of the child and family.

**Respiratory Relief.** Most new approaches in treatment are focused on the lung. The targeted outcomes are improved airway clearance, thinning of secretions, treatment of infections, and reduction of inflammation. **Antimicrobials** may be given as a preventive measure against respiratory infection; however, this treatment is subject to controversy. Full dosages of antimicrobials are given in an acute infection. The physician determines the particular antimicrobial to be used on the basis of the results of throat and sputum cultures. The route may be oral or intravenous. Intravenous medication may be given via **heparin lock** or, in some cases, a Broviac catheter or implanted port. This can be used successfully in both inpatient and outpatient settings. The child’s respiratory status can be monitored through the pulmonary function test, which indicates the lung’s capacity.

**Intermittent aerosol therapy** is administered to provide medication to the lower respiratory tract and to promote evacuation of secretions. DNase, an enzyme, is administered by inhalation and results in decreasing the viscosity of the sputum. An inhaled antimicrobial, tobramycin (TOBI), is being used as a maintenance prophylactic with chronic antimicrobial, tobramycin (TOBI), is being used as a maintenance prophylactic with chronic *Pseudomonas aeruginosa* to help suppress bacterial growth. Bronchodilators such as Albuterol are used to increase the width of the bronchi, allowing free passage of air into the lungs.

Postural drainage, chest clapping, and breathing exercises are also important. These are performed by the respiratory therapist during hospitalization. When postural drainage and chest clapping are done properly, the secretions in the chest are moved up and out. During latent periods or in mild cases, the child may not raise sputum. This should be explained to the parents so that they do not discontinue this valuable procedure when the child goes home. Instructions may need to be repeated frequently to encourage full cooperation of the parents and child. These procedures should be done after nebulization and at least 1 hour after eating. General exercise is good for the child because it stimulates coughing. Somersaults, headstands, and wheelbarrow play within the child’s endurance are therapeutic.

Preventing respiratory tract infections is important. The child should be isolated from individuals and personnel who may harbor infections. The child must be given the necessary immunizations against childhood diseases. Appropriate boosters should be given so that the immunity obtained is kept up to date.

**Diet.** Adequate nutrition is essential. The diet should be high in calories, as much as 50% more than normal. There should be increased protein and moderate amounts of fat in conjunction with pancreatic extracts. Simple sugars are easy to digest, and banana products are particularly good. Fruits, cottage cheese, vegetables, and lean meats, which are high in protein and low in fat and starches, are recommended. With the improvement of nutritional enzymes, many of these children can tolerate normal to higher amounts of fat in their diet. Enzymes can be adjusted if there is an increased amount of fat in the stool. Extra salt may be provided with pretzels and salted breadsticks and crackers. As the disease progresses, some children will benefit from nighttime feedings with a nasogastric tube or **gastrostomy tube (G-button).** Older children can add supplemental drinks such as Boost or Ensure to increase their calorie input.

Supplements of vitamins A, D, and E in a water-miscible base are given each day in double the recommended dose. Vitamin K may also be given when indicated. Salt tablets may be given to the older child during hot weather. Forcing fluids may be ordered because larger amounts of fluid are lost in the stools. The nurse may be asked to weigh the child daily.

The nurse feeding the infant with CF must be calm and unhurried. The infant may cough, have difficulty breathing, and vomit. Careful burping is necessary to avoid abdominal distention. In general, the appetite is good. Older children need small amounts of food served attractively and frequently. Food piled high on a child’s tray is discouraging. The amount of a meal eaten should be compared to what the child normally ingests rather than the amount left on the tray. This practice will decrease a child’s appetite being reported as poor. The nurse records the fluid intake at the end of the meal. The child’s reaction to new foods and any variations in stools resulting from the food are noted. The food refused and the type, character, and amount of vomiting, if any, are also noted.

**Nursing Brief**

Because mealtime is a social time, the nurse should remain with the child if the parents are not present. Try to make the meal more satisfying by giving good companionship mixed with a little encouragement.

**General Hygiene.** The nurse must pay special attention to the skin of the child with CF. The diaper area should be cleansed after each bowel movement. An ointment to protect the skin is advisable because the character of the stool subjects the diaper area to irritation. The buttocks are exposed to air when a rash occurs. Careful attention to bony areas is necessary to prevent decubitus ulcers. Because the child has little fat and muscle, it is important that the position be changed frequently, especially if the child is weak and cannot get out of bed. This also prevents pneumonia.
The child should wear light clothing to avoid becoming overheated; it should be loose to allow freedom of movement. Good oral hygiene is necessary because the teeth may be in poor condition from dietary deficiencies. Mouth care is given after postural drainage because foul mucus may be raised, leaving an unpleasant taste in the child’s mouth.

**Long-Term Care.** Today the child with a chronic illness spends most of the time at home and is hospitalized mainly for diagnosis, relapses, and complications. Caring for a child with a chronic illness is extremely taxing financially, physically, and emotionally. Somehow the family must distribute their time and energy within the family yet give careful attention to the sick child or, in the case of CF, sometimes children. Questions the family must answer are: How do they keep from spoiling the child? Do they limit the normal activities of the remaining children to spare the sick one? What about birthday parties, camping, Cub Scouts, pets, epidemics at school? What does a trip to the shore or mountains entail? When do the husband and wife find time for themselves? These seemingly overwhelming problems are being faced daily by many people in every community. Parent groups are helpful in promoting exchange of ideas and in providing support. The National Cystic Fibrosis Research Foundation disseminates useful information. The nurse should become familiar with the local chapter to guide parents to reliable sources of information.

**Communication**

Parents of children with CF need encouragement and reassurance. If you are asked direct questions about the illness, you might say, “Dr. Parker is a fine pediatrician. What did he tell you about Bobby’s illness?” This encourages the parents to express themselves and gives you an idea of what the child and parents have been told.

Parents need explicit instructions regarding diet, medication, postural drainage, prevention of infection, rest, and continued medical supervision. Plan teaching periods, and provide printed materials for reinforcement so that parents are not overwhelmed. Many families require the assistance of a social worker to secure funds for equipment and drugs. Parents should be told that help is available as the need arises. The mother, who is usually more directly involved, may benefit from these added hints:
- She needs rest herself; the family must take over some of the responsibilities of the household. Relatives may care for the child periodically so that she can “get away from it all.” Respite care is another alternative; it is helpful if she can develop at least one outside interest of her own.
- An alarm clock set for medication time reminds her of this task.
- A downstairs bedroom for the child is preferable.
- Extra spoons and a pitcher of water on the bedside stand save steps.

**Emotional Support.** The child who is chronically ill may find it hard to accept decreasing activity abilities. The amount and kinds of diversion required vary in CF because the disease affects children of all ages, with variations in severity.

It is believed that children benefit from simple straightforward answers about the illness. An uncomplicated diagram might be helpful. Children who understand why they are being restricted from certain activities are more cooperative. They should know why they must take medications with each meal, use the nebulizer, undergo postural drainage, and so on. They should see and handle the unfamiliar equipment necessary for their care.

The young child may find it difficult to be separated from the parents during hospitalization. Even when the prognosis is grave, a child’s courage is sustained if the parents are there. Parents are encouraged to stay with the child when possible. Close contact by mail with school, church, and clubs is important for school-age children. It is helpful for the child to develop an activity at which they are good, such as piano or art. This increases their feeling of worth and provides outlets for emotions. Consideration must be given to ways of fostering love, acceptance, trust, fair play, security, freedom of choice, creativity, and self-identity.

Nurses should learn the child’s likes, dislikes, fears, and interests. They should observe them with their families and note the types of relationships that exist. They then can form their own impressions about the child and are not misled by labels given them by those with less understanding. Children have to be allowed to communicate in a manner that is meaningful to them. Sometimes children are able to express feelings; sometimes they are not. Drawing with children may stimulate conversation. It is important that nurses be aware of children’s facial expressions, posture, eyes, and how they play. What are they saying to their toys, their playmates? Nurses’ observations of children’s behavior should be incorporated into nursing care plans.

Nurses and parents must not show undue concern for a child’s illness. Overindulging children has a tendency to make them demanding. Children may then exaggerate small problems. The children’s impressions of themselves and their illness are determined a good deal by how they feel physically, how the family feels about their condition, and how others behave toward them.
Development of new approaches in treatment has changed the outlook for CF families. Advancements in airway clearance techniques, new medications, gene therapy, and lung transplantation have encouraged optimism toward improvement of lifestyle for the child with CF. The nurse should assist in keeping families informed of new, available therapies (Nursing Care Plan 11-1). As many of these children are living into adulthood, they will need to be transitioned into an adult health care setting.

CROUP

Respiratory infections are common in the pediatric population, especially in children younger than 5 years of age. Children have smaller air passages than adults and experience more narrowing with inflammation. Acute infections of the larynx are common in the toddler. Involvement of other parts of the respiratory tract is frequent. A wide variety of organisms cause croup, but most often the infectious agent is a virus. The child's history is valuable in the diagnosis because there appears to be a familial tendency. Although it can occur at any age, it is most common in children between 3 months and 6 years of age.

Croup is a nonspecific term applied to a number of conditions, the chief symptom of which is a brassy (croupy) “barking” cough and varying degrees of inspiratory stridor. When the larynx is involved, the picture becomes more serious because of possible alterations in respiratory status (e.g., airway obstruction, acute respiratory failure, or hypoxia). Acute spasmodic laryngitis is the milder form of the syndrome. Acute laryngotracheobronchitis is the most common. It is also referred to as glottic and subglottic croup. Figure 11-4 illustrates croup.

Signs and Symptoms

Croup usually begins with an upper respiratory infection with or without fever. The child begins to develop hoarseness and a harsh, barking, “croupy” cough. As the subglottic area becomes obstructed by edema and exudate, the child develops stridor, a harsh,

![Diagram of normal and obstructed larynx]

- Epiglottis
- Trachea
- Mucosal inflammation and edema narrow airway
- Sudden onset of harsh, metallic cough, inspiratory stridor or hoarseness
- Respiratory distress
- Substernal or suprasternal retractions
- Agitation
- Pallor or cyanosis
- Increased heart rate, extreme restlessness or listlessness
- Hypoxia

**FIGURE 11-4** Pathophysiology of croup.
### Nursing Care Plan 11-1  The Child with Cystic Fibrosis

#### Nursing Diagnosis  
**Ineffective airway clearance, related to accumulation of mucus**

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td>The child has improved aeration, as evidenced by:</td>
<td></td>
<td>Provides information on how the child is doing.</td>
</tr>
<tr>
<td>• Absence of dyspnea and tachypnea</td>
<td>Assess lung sounds: rate and depth.</td>
<td>As oxygen is needed, the heart speeds up to help the body compensate.</td>
</tr>
<tr>
<td>• Ability to expectorate mucus</td>
<td>Assess oxygen saturation.</td>
<td>Fluids are needed by the body to help thin secretions.</td>
</tr>
<tr>
<td>• Respiratory rate appropriate for age</td>
<td>Provide adequate hydration.</td>
<td>Bronchodilators and an increase in the inspired humidity aid the functioning of the respiratory</td>
</tr>
<tr>
<td>• Heart rate appropriate for age (O2 saturation = 93% on room air)</td>
<td>Assist child with aerosol therapy.</td>
<td>system and aid in expectorating mucus.</td>
</tr>
<tr>
<td></td>
<td>Assist with chest physiotherapy and postural drainage.</td>
<td>Aids in expectorating mucus by dislodging mucous plugs and, with the addition of gravity, aids in</td>
</tr>
<tr>
<td></td>
<td>Administer medications and explain their use.</td>
<td>removal of mucus from the body.</td>
</tr>
<tr>
<td></td>
<td>Teach child the importance of breathing exercises.</td>
<td>Breathing exercises increase the body’s ability to compensate.</td>
</tr>
<tr>
<td></td>
<td>Monitor the effectiveness of medication and respiratory treatments.</td>
<td>As the child grows and as the body’s needs change, adjustments are needed in the course of treatment.</td>
</tr>
</tbody>
</table>

#### Nursing Diagnosis  
**Imbalanced nutrition, less than body requirements, related to malabsorption from absence of pancreatic enzymes**

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td>The child has adequate nutrition, as evidenced by:</td>
<td></td>
<td>Indicates what information is needed for the child and the family.</td>
</tr>
<tr>
<td>• Ability to eat 1 1/2 to 2 times the recommended dietary allowance for age</td>
<td>Assess baseline nutrition.</td>
<td>The body lacks the ability to excrete the pancreatic enzymes needed to digest fats and proteins.</td>
</tr>
<tr>
<td>• Weight gain or lack of weight loss</td>
<td>Administer pancreatic replacement enzymes.</td>
<td>Fat-soluble vitamins are given in a water-soluble form to aid in the absorption of these vitamins.</td>
</tr>
<tr>
<td>• Increase in muscle mass</td>
<td>Administer water-miscible fat-soluble vitamins.</td>
<td>Electrolytes, particularly sodium, are lost in large amounts during periods of heavy perspiration</td>
</tr>
<tr>
<td>• Maturation in growth and development</td>
<td>Monitor serum electrolytes.</td>
<td>(fever, hot weather, exercise).</td>
</tr>
<tr>
<td></td>
<td>Provide a diet high in calories and proteins and normal in fat.</td>
<td>Because of the body’s inability to absorb nutrients, it is necessary for there to be an abundance.</td>
</tr>
<tr>
<td></td>
<td>Provide between-meal snacks or supplemental drinks.</td>
<td>Extra energy is also used by the respiratory system.</td>
</tr>
<tr>
<td></td>
<td>Monitor caloric count.</td>
<td>Adds additional calories and nutrients.</td>
</tr>
<tr>
<td></td>
<td>Teach child and caregiver the importance of daily evaluation of diet.</td>
<td>A calorie count is needed to ensure that the child is getting the needed calories and nutrients.</td>
</tr>
<tr>
<td></td>
<td>Weigh daily, and record while in the hospital.</td>
<td>Allows the family to function in an independent manner; adjustments can be made more easily.</td>
</tr>
<tr>
<td></td>
<td>Monitor and record characteristics of stool.</td>
<td>Diet and activity can be adjusted according to needs.</td>
</tr>
<tr>
<td></td>
<td>Consult with the dietitian.</td>
<td>Because it is difficult for the body to digest fats, the stool record aids in identifying needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>adjustments to the diet and medication regimen.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A dietitian is an integral part of the team in the treatment and management of the child. A dietitian</td>
</tr>
<tr>
<td></td>
<td></td>
<td>can provide information for the child and the family and aid them in their selections.</td>
</tr>
</tbody>
</table>
### Nursing Care Plan 11-1 The Child with Cystic Fibrosis—cont’d

#### Nursing Diagnosis: Deficient knowledge, related to the diagnosis and condition of the child

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
</table>
| The parents have an understanding of what is occurring, as evidenced by:  
• Repeating information correctly that has been given to them  
• Asking questions  
• Describing the home care regimen  
• Discussing the need for medical follow-up  
• Ability to express fears  
• Accepting referrals for outside assistance | Assess parents’ understanding of the disease process and its future outcome.  
Provide emotional support for the parents and the child.  
Allow the parents to ask questions.  
Answer questions, or provide parents with resources to answer their questions.  
Help parents understand and support the child through various activities.  
Encourage parents’ participation in the care of the child.  
Assess the home environment for long-term care.  
Initiate referral to aid the parents.  
Teach parents and child the signs and symptoms of respiratory distress.  
Consultation or referral with social service. | Allows the nurse to know where to begin.  
Parents may find it difficult to deal with all that is going on. Make sure both the parents’ and the child’s needs are met.  
The nurse may not have all the answers to the questions asked, but it is important that resources be used. Find out for the parent or direct the parent where to go (e.g., “That is a good question. Let’s write it down so you can ask your doctor when he comes in.”).  
If parents can support the child in the hospital, then they are more likely to be successful in a home setting.  
Parents who participate in care can show their concern for the child and feel they are team players in the management of the child.  
Allows for home-care plans to be made. |

#### Nursing Diagnosis: Risk for infection, related to invasion of respiratory system by bacterial organisms

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
</table>
| The child is free of infection, as evidenced by:  
• Remaining afebrile  
• Respiratory rate appropriate for age  
• Clearing of mucus after regular and routine respiratory treatments  
• Following proper procedure when doing treatments | Assess vital signs.  
Teach the importance of hand hygiene.  
Encourage proper pulmonary hygiene.  
Teach proper handling and disposal of secretions and sputum.  
Teach or review with the child and parents why the pulmonary system is at risk for infection.  
Give reassurance and praise when procedures are done correctly by the child or parents.  
Provide guidance related to being independent. | Early recognition of changing vital signs alerts nurse to the possibility of an infection.  
Done properly, hand hygiene can decrease the spread of organisms.  
By getting rid of mucus and secretions, there is less opportunity for harmful organisms to multiply and spread.  
Information helps the child and family understand the need to be careful and follow recommendations; aids with compliance in treatment.  
Shows that nurse recognizes the child or family has learned and gives them more motivation to learn. The more motivated the child and family are to learn, the more compliant they are in following procedures.  
Independence increases self-esteem. As learning increases, the child is able to be more independent and self-esteem is greater. |
CHAPTER 11  Respiratory Disorders

Goals/Outcome Criteria Nursing Interventions Rationales

Critical Thinking Snapshot
A newly diagnosed 5-year-old with CF is having difficulties adjusting to the new routines. While he is cooperative with his airway clearance vibration vest, he refuses to take pancreatic enzymes with meals. The mother is frustrated and is threatening the child.
1. What interventions could the nurse use in attempting to obtain compliance with this child?
2. How can the nurse help the mother become more effective in dealing with the situation?

Nursing Care Plan

The Child with Cystic Fibrosis—cont’d

high-pitched sound when breathing. Cough and stridor are usually worse at night. Although croup is alarming to the child and parents because the child is distressed, most cases are mild, and it is not communicable. Signs of pallor, increased respiratory effort, and restlessness indicate that the child should be seen by a physician because respiratory distress is increasing.

Treatment and Nursing Care

Most children can be managed at home. Use of steam from a shower or hot bath in a closed bathroom can often stop the acute respiratory distress and laryngeal spasm. Parents should be instructed to use a cool mist humidifier in the child’s room. The machine must be disinfected regularly. Steam vaporizers are usually avoided because of the danger of scalding. Exposure to cold air can relieve stridor. Many a parent has carried a child out into the cold night on the way to the emergency room only to have the child appear quite comfortable when they arrive at the hospital. This may be caused by the colder atmospheric air cooling the upper airway mucosa and decreasing local edema (Kliegman et al., 2007). Clear fluid intake should also be increased to assist with preventing dehydration, preventing thickened secretions, and decreasing a fever.

Children with croup and temperatures above 102.2°F (39°C) should be hospitalized if there is progressive stridor, respiratory distress, or suspected epiglottitis (Kliegman et al., 2007).

The child admitted to the hospital with respiratory distress is anxious and fatigued. A calm, reassuring approach by the nurse can relieve the child’s and family’s anxiety. As the parents become more relaxed, the child also becomes less apprehensive.

Low-dose oxygen or supplemental oxygen with a nasal cannula or mask might be used if the child is hypoxic. Keeping the mask on a small child can be challenging, while a nasal cannula that is taped to the child’s cheek and back may provide a more comfortable route of administration. Helium-oxygen mixtures (heliox) are being used for upper airway obstruction including croup. There are limitations with heliox as it requires greater than 40% oxygen, expense, and complexity of setup. For children who cannot use corticosteroids or epinephrine, this is an effective treatment (Wald, 2010).

Medications used in the treatment of croup include corticosteroids and inhaled racemic epinephrine. Corticosteroids have proved helpful in avoiding intubation in seriously ill children by decreasing subglottic edema. Racemic epinephrine is inhaled via a face mask. It decreases edema by vasoconstriction and provides immediate relief, although this may be temporary. Racemic epinephrine may be repeated in several hours if necessary. A single inhaled dose peaks in 10 to 30 minutes, with an overall duration of 2 hours. Close observation is necessary because some children may have a relapse, with return of symptoms when the medication effect has worn off. For this reason, many children who have received racemic epinephrine are admitted to the hospital for observation.

The nurse observes and records temperature, pulse, respirations, and blood pressure, if ordered. Particular
Respiratory Disorders

CHAPTER 11

Treatment and Nursing Care

There is no cure for the common cold. When a cold is suspected, treatment should be started early. The treatment is designed to relieve the symptoms. Rest, fluids, and proper diet are important. Parents are taught to watch the child for signs of dehydration. If anorexia is present, food should not be forced. The appetite gradually improves as the condition does. When high fever accompanies a cold, the physician must be consulted. Acetaminophen (Tylenol) reduces the temperature, but the correct dosage should be prescribed, particularly in children younger than 1 year of age. Aqueous nosedrops relieve nasal congestion. The infant needs nosedrops mainly before feedings and at bedtime. When drops are instilled 10 to 15 minutes before feedings, the nasal passages are cleared and the infant can suck easily. Each child needs an individual bottle of nosedrops to prevent cross-infection.

安全警告

The FDA recommends that over-the-counter (OTC) cough and cold products not be used for infants and children younger than 2 years of age. While review of OTC use for children 2 to 11 years of age is not complete, the FDA strongly suggests that if parents use OTC products, they follow these recommendations:

- Check the "active ingredient" as many medications have more than one
- Take care when giving more than one OTC product as they both may have the same ingredients and an overdose might occur
- Follow directions listed on the label
- Only use measuring instruments made for measuring drugs. Do not use household spoons.
- Do not use OTC products to sedate or make children sleepy

(FDA, 2010)
Moist air soothes the inflamed nose and throat. A cold air humidifier is safe and convenient. It should be cleaned and disinfected regularly. If a great deal of moisture is indicated, as for croup, the infant may be taken to a small room, such as the bathroom, and the water faucets can be turned on to create sufficient humidity.

The older child is taught the proper way to remove nasal secretions from the nose. The mouth is opened slightly and secretions are blown gently through both nostrils at the same time. This method prevents infection from being forced into the eustachian tubes. When a large amount of nasal discharge is present, the nurse can apply petroleum jelly to the upper lip to protect it.

In the hospital, the child is isolated with proper isolation restrictions. During the initial stage of the fever, the child is kept in bed. Frequent change of position is necessary. In the home, it is difficult to keep children with a cold away from other members of the family. They must be taught to cover their mouth and nose when sneezing and to wash their hands afterward. Tissues must be properly discarded. The child should stay at home without visitors. Rest, fluids, and adequate nutrition support recovery.

**TONSILLITIS AND ADENOIDITIS**
The tonsils and adenoids, located in the pharynx, or throat, are made of lymph tissue and act as part of the body’s defense mechanism against infection. Group A streptococci are normal flora of the oropharynx and pharynx, and up to 20% of the pediatric population are colonized by this bacteria. However, infectious pathogens such as *Haemophilus influenzae, Staphylococcus aureus, S. pneumoniae, and Moraxella catarrhalis* are also sources of infection. Penicillin is often the drug of choice to treat streptococcal pharyngitis.

The tonsils and adenoids formerly were blamed for causing many assorted illnesses, and for a time it was thought that having them removed was part of growing up. Today, doctors carefully evaluate the need for children to have them removed. A careful physical examination and an evaluation of the child’s history are done to rule out other diseases. Enlargement of the tonsils is not sufficient reason for removal. These structures are normally larger in early childhood than in later years. The current trend is to treat the conditions as separate problems, according to individual criteria. Obstructive sleep apnea syndrome, multiple infections, and peritonsillar abscess are indications for tonsillectomy.

**Treatment and Nursing Care**
The use of antimicrobials during acute infections has reduced the need for surgery. The decision as to whether surgery is necessary is perhaps the single most important factor from a medical standpoint. Ideally, children are beyond toddlerhood when this surgery is performed. They are better able to understand what is happening, and they are more compliant as a result.

Most children are referred to an ear, nose, and throat specialist when contributing conditions become severe. An acute streptococcal infection should be treated prior to surgery. Surgery is usually performed in day surgery units. New surgical tools are being used for tonsillectomy and adenoidectomy. According to Messner (2003), one such instrument is the ultrasonic dissector coagulator, which uses ultrasonic technology to cut and coagulate tissues at lower temperatures than that used with electrocautery. This ultimately minimizes tissue damage (and possibly, postoperative pain).

**Preoperative Care.** The child is prepared in advance for surgery. Children need to know that the tonsils are two small lumps located far in the back of the mouth. Because they are causing the throat to be sore (or whatever symptoms the child is experiencing) and are not working properly, they need to be taken out. Reassure children that the doctor will not operate on any other part of the body and that it is all right for the tonsils to come out. Children are also informed that they will receive a special medicine that will make them go to sleep and will keep them asleep until the operation is over. Emphasize that after the operation they will wake up. After they wake up, they will be sore for several days, but pretty soon they will feel entirely better. Medical personnel and parents must be alert to the young child’s fantasies and anxieties and answer questions honestly and at a level suitable to the age of the child.

Many hospitals have special programs to prepare children for surgery. These programs provide videotapes, prehospitalization tours, and opportunities to handle supplies. Familiarization with equipment and the setting reduces fear. Allowing children hands-on play therapy also minimizes fear (Figure 11-6).
Respiratory Disorders

CHAPTER 11

Postoperative Care. Nursing care is focused on providing comfort and minimizing potential bleeding. Immediately after surgery, to facilitate drainage, the child is placed partly on the side and partly on the abdomen (prone), with the knee of the uppermost leg flexed to hold the position. The child is watched carefully for evidence of bleeding. Hemorrhage is the most common postoperative complication. The nurse should not assume that because surgery is minor it does not involve certain risks. Because bleeding after this type of surgery is concealed, the nurse must watch carefully for evidence of hemorrhage (see Did You Know). When bleeding is suspected, packing and sometimes ligation are indicated. Lung abscesses and pneumonia are infrequent complications.

Did You Know

The Child with Possible Post-Tonsillectomy Bleeding

- Frequent swallowing (a cardinal sign of bleeding)
- Pallor
- Restlessness
- Increased pulse
- Vomiting bright red blood
- Decreasing BP
- Visible blood on careful examination of the throat with a flashlight

An ice collar may be applied for comfort. Some children prefer not to have an ice collar. Most children experience pain and should be medicated. Acetaminophen, with or without codeine, increases comfort and may assist in lessening crying, which can irritate the operative site. Rectal or IV analgesics also may be used.

The child is given fluids intravenously during surgery. It is not uncommon for vomiting to occur. Small amounts of cool, clear liquids are given when the vomiting has ceased. Avoid citrus juices, carbonated drinks, and milk products. Avoid extremely hot or cold fluids as they may irritate the throat. A Popsicle may appeal to the child; however, red juices or Popsicles are not to be given because monitoring for bleeding is an important nursing consideration. If clear liquids are well tolerated, progression to a soft diet is begun. The child is kept quiet for the remainder of the day. A small child may nestle on a parent’s lap.

Discharge

Written instructions are given to the parents when the child is discharged. The child should be kept quiet for a few days and should receive nourishing fluids and soft foods. After this, children may continue to take a nap or have a rest period so that they have a sufficient convalescent time. Acetaminophen (Tylenol) may be given to reduce discomfort in the throat. The child needs to be protected from exposure to infections.

FIGURE 11-7 Parental presence during induction of anesthesia can minimize the child’s and parents’ anxiety during the preoperative period.
Fresh bleeding, chest pain, or persistent cough should be reported to the physician. Although it occurs rarely, bleeding can occur up to 10 days after surgery from tissue sloughing from the healing process (Hockenberry and Wilson, 2007). The doctor may compare this with a “scab” coming off. Earache may follow a tonsillectomy and/or adenoidectomy, and slight fever (99°F to 100°F or 37.2°C to 37.8°C) may occur for 2 or 3 days. A follow-up appointment is made because the surgeon will wish to check the operative site after it has healed. The child usually can resume normal activities within 2 weeks.

**ASTHMA**

Asthma is the most common chronic illness in childhood. It is also the leading cause of emergency department visits, hospital admissions, and school absenteeism (Kliegman et al., 2007). Eighty percent of cases of asthma occur before 5 years of age. Asthma is more frequently seen in poor children, partly because they live in old homes with high concentrations of precipitating allergens. School nurses are seeing an increasing number of children with asthma on a daily basis and require a good understanding of the course of treatment for asthma. Nurses are giving inhalation treatments in school; such treatments can help the child manage the condition on a day-to-day basis.

Asthma is a reversible obstruction of the large and small airways caused by mucosal edema, smooth muscle constriction, and thick tenacious mucus. Also known as **reactive airway disease**, asthma may be precipitated by allergens such as pollens, foods, dust mites, and animal dander, which irritate the airways and initiate bronchoconstriction and the inflammatory process. Asthma may also be triggered by temperature changes, cold air, viral infections, and exercise. One of the major triggers of asthma is exposure to cigarette smoke.

Signs and Symptoms

Symptoms can occur abruptly (e.g., after sudden exposure to cold air or cigarette smoke) or after a period of days (precipitated by upper respiratory infection or mild exposure to an allergen). Initially the child has a tight nonproductive cough. Wheezing, particularly expiratory wheezing, may be audible or heard through a stethoscope. Depending on the severity of the problem, the child can develop signs of increasing respiratory distress (e.g., tachycardia, dyspnea, tachypnea, retractions, pallor). The child might have difficulty talking and appears tired.

Asthma is categorized into four classifications (Table 11-1). Appropriate management of asthma will depend on the symptoms of the child, which determine the classification. These classifications use a sidestep approach for pharmacologic management, control of the environment, and family education. Included in the asthma classifications are impairment and risks, which looks at the effect of asthma on present quality of life and future risks. A baseline measurement of the **peak expiratory flow rate (PEFR)**, or the force of expiration from maximum lung inflation, is a component of the classifications. This is done with a special meter, which most children older than 5 years of age can be taught to use successfully. Children determine their personal best PEFR over a 2-week period of testing twice a day (Hockenberry and Wilson, 2007). Then daily (or more frequent) monitoring of PEFR and comparison with the child’s personal best can indicate how well the asthma is being controlled.

Oxygen saturation monitoring can help determine the severity of an episode. The child may exhibit elevated eosinophils in a complete blood cell count (CBC) and elevated immunoglobulin E (IgE) levels. Allergy skin tests may reveal precipitating allergens. Chest radiographs can show underlying respiratory infection. Pulmonary function test (PFTs) are used to diagnose and evaluate lung function.

Some school-age children and adolescents have exercise-induced bronchospasm, which often does not indicate underlying asthma. Wheezing, shortness of breath, and chest tightness appear after vigorous exercise. There is bronchoconstriction without underlying inflammation. Treatment of exercise-induced bronchospasm consists of taking an inhaled β-agonist 15 minutes before exercise. Also effective is the use of leukotriene receptor antagonists with exercise-induced asthma. These drugs are more attractive because of the oral route and decrease dependency. The child should avoid exercising in the cold because cold air can precipitate the condition.

**Treatment and Nursing Care**

The goal of treatment is to appropriately manage the condition so the child can maintain optimal lifestyle and development. The treatment is focused on reducing episodes, minimizing the inflammatory process, decreasing the number of hospitalizations, avoiding precipitating factors, and facilitating normal growth and development. Untreated persistent asthma can
### Table 11-1 Classifications of Asthma Severity in Children

<table>
<thead>
<tr>
<th>Impairment</th>
<th>INTERMITTENT</th>
<th>PERSISTENT</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGES</td>
<td>0-4 YRS</td>
<td>5-11 YRS</td>
<td>0-4 YRS</td>
<td>5-11 YRS</td>
<td>0-4 YRS</td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2 days/week</td>
<td>≤2 days/week but not daily</td>
<td>Daily</td>
<td>Through the day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>0 ≤2×/month</td>
<td>1-2×/month</td>
<td>3-4×/month</td>
<td>≥1×/week but not nightly</td>
<td>&gt;1×/week</td>
<td>Often 7×/week</td>
</tr>
<tr>
<td>Short-acting β2-agonist use for symptom control</td>
<td>≤2 days/week</td>
<td>&gt;2 days/week but not daily</td>
<td>Daily</td>
<td>Several times per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interference with normal activity</td>
<td>None</td>
<td>Minor limitation</td>
<td>Some limitation</td>
<td>Extremely limited</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung function</td>
<td>Normal FEV between exacerbations</td>
<td>N/A &gt;80%</td>
<td>N/A &gt;80%</td>
<td>N/A 60%-80%</td>
<td>N/A &lt;60%</td>
<td></td>
</tr>
<tr>
<td>FEV (predicted) or peak flow (personal best)</td>
<td>N/A &gt;85%</td>
<td>N/A &gt;80%</td>
<td>N/A 75%-80%</td>
<td>N/A &lt;75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEV/FVC</td>
<td>N/A &gt;85%</td>
<td>N/A &gt;80%</td>
<td>N/A 75%-80%</td>
<td>N/A &lt;75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk</td>
<td>0-1×/year</td>
<td>≥2 exacerbations in 6 months requiring oral systemic corticosteroids, or ≥4 wheezing episodes/1 year lasting &gt;1 day and risk factors for persistent asthma</td>
<td>≥2×/year</td>
<td>≥2×/year</td>
<td>≥2×/year</td>
<td>≥2×/year</td>
</tr>
</tbody>
</table>

lead to permanent and irreversible damage to lung function.

The physician should obtain the child’s history in detail. Skin tests may be administered to determine whether allergy is a cause. If so, it is necessary to eliminate the offender, whether it is an environmental agent or a food. Special measures should include reducing dust mites, mold, animal dander, cockroach allergens, and tobacco smoke in the home.

Medications are classified into two categories: long-term medications (controllers) and quick-relief medications (rescuer). Table 11-2 lists the common medications in both categories. The drug of choice for first-time therapy for children older than 5 years of age is inhaled corticosteroids. Quick-relief and long-term medications can be used in combination to manage asthma effectively.

The preferred route of administration for many of these medications is inhalation because it allows the medications to act directly on the airways. Inhalation treatments can be given via nebulizer (Figure 11-8), in which the medication is mixed with normal saline solution and aerosolized; metered-dose inhaler (MDI); or dry powder inhaler (DPI). Bronchodilators can also be given via MDI if the child is able to follow the instructions (Skill 11-1). Most children older than 5 years of age can manage an MDI. Some younger children can use an MDI with an attached spacer device, which directs the medication more precisely and has excellent outcomes. Spacers help reduce infections that can result from the corticosteroids.

Leukotriene modifiers (e.g., Singulair, Accolate) have been useful for the prevention of asthma attacks. They are used in conjunction with corticosteroids and can reduce the level of need for corticosteroids. Singulair is given daily, and Accolate is given twice a day. Omalizumab is an anti-IgE antibody that is administered by subcutaneous injection and is recommended for moderate to severe allergy-related asthma in children 12 years of age or older (NAEPP, 2007).

**Nursing Brief**

The key to chronic asthma management is long-term control of airway inflammation. Education is the key to reducing underappreciation of the disease, failure to follow treatment guidelines, lack of adherence, and difficulty with inhalation devices.

Children with acute exacerbations of asthma, which require a visit to the doctor’s office or emergency room, usually are treated with nebulized albuterol every 20 minutes for 1 hour with oxygen. If the symptoms improve, the child is placed on a daily routine of bronchodilators and short-term oral steroids (3-day to 5-day course). If the child’s condition does not resolve and the oxygen saturation is less than 90%, the child should be admitted to the hospital.

On admission, an intravenous solution is started and oxygen is given with nasal prongs, hood, or mask. Nebulized albuterol is continued either continuously or intermittently. Anticholinergic drugs, such as ipratropium bromide, may be added to assist in additional bronchodilation. Currently, aminophylline does not appear to provide additional benefits and is not usually administered. For severe airway obstruction that does not respond to treatment, aminophylline may be administered. Because aminophylline can cause cardiac dysrhythmias, children receiving aminophylline intravenously should be placed on a cardiac monitor during the course of therapy. Intravenous steroids, such as methylprednisolone, are administered to control the inflammatory response. Before discharge, the treatment is changed to oral medication.

**Facilitating Optimal Gas Exchange.** Place the child in a high Fowler’s position. Some children may prefer to have a pillow placed on the over-bed table and to extend their arms over it. This allows maximal use of the accessory muscles of breathing. The child may receive humidified oxygen with mask or cannula. Infants and young children often do better with nasal prongs because they do not feel they are suffocating as they might with a mask. An oxygen mask should not be used if it increases the child’s anxiety.

The nurse should organize care to provide for periods of uninterrupted rest. Cuddling and rocking the younger child often reduce distress and promote sleep. Older children can be distracted with quiet music or games.

Vital signs, breath sounds, and a respiratory assessment, which includes oxygen saturation measurement, are done at least every 2 to 4 hours. Children in acute distress are monitored more frequently.

The child may be apprehensive because of the respiratory distress. The nurse should display a calm...
<table>
<thead>
<tr>
<th>Controller</th>
<th>Trade Name</th>
<th>Dose Form</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-Term Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhaled Corticosteroids (ICS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beclomethasone dipropionate</td>
<td>Beconase, QVAR</td>
<td>MDT, intranasal</td>
<td>Growth retardation, nasal irritation, unpleasant taste, headache; not recommended for children younger than 6 years</td>
</tr>
<tr>
<td>Budesonide</td>
<td>Rhinocort, Pulmicort</td>
<td>MDI, intranasal</td>
<td>Growth retardation, nasal irritation, dry mouth; avoid chickenpox exposure</td>
</tr>
<tr>
<td>Flunisolide</td>
<td>Aerobid, Nasalide</td>
<td>MDI, intranasal</td>
<td>Growth retardation, gastrointestinal upset, unpleasant taste; not recommended for children younger than 6 years</td>
</tr>
<tr>
<td>Fluticasone propionate</td>
<td>Flovent, Flonase</td>
<td>MDI, intranasal</td>
<td>Nausea, vomiting, dizziness, dental problems</td>
</tr>
<tr>
<td>Formoterol</td>
<td>Foradil</td>
<td>MDI</td>
<td></td>
</tr>
<tr>
<td><strong>Systemic Corticosteroids</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>Medrol, Solu-Medrol</td>
<td>Oral</td>
<td>Mask infection, growth retardation, cushingoid signs, oral thrush</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>Prelone, Orapred, Pedipred</td>
<td>Oral</td>
<td>Insomnia, nervousness, mood swings, facial flushing</td>
</tr>
<tr>
<td>Prednisone</td>
<td>Sterapred</td>
<td>Oral</td>
<td>Insomnia, headache, nervousness, appetite changes, mood swings, nausea, vomiting</td>
</tr>
<tr>
<td><strong>Antiinflammatory Agents</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cromolyn sodium</td>
<td>Intal, Crolom, Nasalcrom</td>
<td>MDI, intranasal, oral</td>
<td>Fatigue, unpleasant taste, tachycardia, headache, rash, nasal congestion</td>
</tr>
<tr>
<td>Nedocromil</td>
<td>Tilade</td>
<td>MDI</td>
<td>Headache, unpleasant taste, cough, nausea</td>
</tr>
<tr>
<td><strong>Leukotriene Receptor Antagonist (LTRA)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zafirlukast</td>
<td>Accolate</td>
<td>Oral, chewable tablet</td>
<td>Headache, nausea, vomiting, dizziness</td>
</tr>
<tr>
<td>Montelukast</td>
<td>Singulair</td>
<td>Oral</td>
<td>Headache, fiulike symptoms, abdominal pain</td>
</tr>
<tr>
<td><strong>Long-Acting β₂-Agonists (LABA)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salmeterol</td>
<td>Serevent</td>
<td>MDI, diskhaler</td>
<td>Tachycardia, tremor, nervousness, headache</td>
</tr>
<tr>
<td>Theophylline</td>
<td>Slo-bid, Theo-dur</td>
<td>Oral</td>
<td>CNS hyperstimulation, seizures</td>
</tr>
<tr>
<td><strong>Immunomodulators (Anti-IgE Antibodies)</strong></td>
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<tr>
<td>Omalizumab</td>
<td>Xolair</td>
<td>SubQ</td>
<td>Headache</td>
</tr>
<tr>
<td><strong>Quick Relief (Rescue)</strong></td>
<td></td>
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</tr>
<tr>
<td>Short-Acting β₂-Agonists (SABA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albuterol</td>
<td>Proventil, Ventolin</td>
<td>MDI, syrup, Neb</td>
<td>Tremors, anxiety, insomnia, tachycardia, heartburn, vomiting</td>
</tr>
<tr>
<td>Pirbuterol</td>
<td>Maxair</td>
<td>MDI</td>
<td>Tremors, nervousness, hypertension, tachycardia,</td>
</tr>
<tr>
<td>Terbutaline</td>
<td>Brethine, Brethaire</td>
<td>MDI, Inject</td>
<td>Tremors, anxiety, insomnia, tachycardia, heartburn, vomiting</td>
</tr>
<tr>
<td>Levalbuterol</td>
<td>Xopenex</td>
<td>Neb</td>
<td>Tachycardia, tremor, insomnia, nausea, headache</td>
</tr>
<tr>
<td><strong>Systemic Corticosteroids</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>Medrol</td>
<td>Oral</td>
<td>Mask infection, growth retardation, cushingoid signs</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>Prelone</td>
<td>Oral</td>
<td>Insomnia, nervousness, mood swings, facial flushing</td>
</tr>
<tr>
<td>Prednisone</td>
<td>Orasone, Deltasone, Mebicorten</td>
<td>Oral</td>
<td>Insomnia, heartburn, nervousness, increased appetite</td>
</tr>
<tr>
<td><strong>Anticholinergics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ipratropium bromide</td>
<td>Atrovent</td>
<td>MDI</td>
<td>Tachycardia, eye pain, cough, nervousness</td>
</tr>
</tbody>
</table>
Respiratory Disorders

following directions in the administration of medications is stressed as is awareness of side effects. The use of nebulizers or aerosol devices is also taught. Review the procedure for measuring PEFR (Skill 11-2). Some peak flow meters are colored like traffic lights. These zones should be individualized by the physician for each child. Remind the child to measure PEFR at the same times each day, usually morning/night. If the child does the measurement after taking routine medications, the measurement should be done 15 minutes after the medication.

Specific information about how often and when to use a particular inhaler is also emphasized. The child needs to be seen regularly by the physician to evaluate progress and adjust medications. Review signs of respiratory infection: where, when, and whom to call for help. The child and family should be aware of early signs of an asthma attack and methods of limiting such an attack.

Regular exercise is stressed. Swimming is an excellent sport for children with asthma, although they can

manner and remain with the child during periods of distress. Often, encouraging the child to breathe slowly, or to breathe along with you as you breathe slowly, decreases anxiety and allows for maximum air exchange.

**Maintaining Hydration.** The child who is hospitalized with asthma should have an intravenous infusion started. If the child is not in acute respiratory distress, clear oral fluids should also be offered. The child’s need for fluids is increased because of fluid loss through dyspnea and diaphoresis. The fluids offered should not be cold because these may cause bronchospasm. The child’s intake and output are measured and monitored.

**Encouraging Self-Care and Asthma Management Skills.** Before discharge, the older child and parent are taught self-care. They are taught to recognize early signs of difficulties and personal triggers that can serve as forewarnings of an attack. The importance of following directions in the administration of medications is stressed as is awareness of side effects. The use of nebulizers or aerosol devices is also taught.

Review the procedure for measuring PEFR (Skill 11-2). Some peak flow meters are colored like traffic lights. These zones should be individualized by the physician for each child. Remind the child to measure PEFR at the same times each day, usually morning/night. If the child does the measurement after taking routine medications, the measurement should be done 15 minutes after the medication.

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Regular exercise is stressed. Swimming is an excellent sport for children with asthma, although they can

1. Remove cap from MDI and hold canister upright.
2. Shake inhaler canister three or four times.
3. Tilt head back slightly and exhale normally.
4. Position inhaler in one of the following ways:
   - Close lips around mouthpiece of inhaler.
   - Open mouth and hold mouthpiece two finger breadths from mouth.
   - Use a spacer.
5. Start to breathe in slowly, and press down on the inhaler to release the medication as you are inhaling.
6. Continue inhaling slowly and deeply (3 to 5 seconds).
7. Hold breath for a count of 10 (5 to 10 seconds) to allow the medicine to reach the lungs, and then exhale.
8. Wait 1 to 2 minutes, and repeat the puff.
9. Rinse out the mouth with water and spit out, especially when taking an inhaled corticosteroid.

**Skill 11-1 Use of a Metered-Dose Inhaler**
participate in many other sports as well. If the child with asthma also has exercise-induced bronchospasm, use of an inhaler before exercising is important. Listen to and provide support for the child, parents, and siblings. Review stress reduction strategies with the child. These often can avert an impending attack. Parents should be encouraged to allow the child to live a normal life within the limits of a chronic condition. Refer the family to social services for additional support and to the Asthma and Allergy Foundation of America or the American Lung Association. Be certain that all children discharged from the hospital have appropriate inhalation equipment for the home management of their condition (Nursing Care Plan 11-2).

EPIGLOTTITIS
Epiglottitis is a swelling of the tissues above the vocal cords—that is, supraglottic (Figure 11-9). This results in narrowing of the airway inlet with the possibility of total airway obstruction. It is most frequently caused by H. influenzae type b infection and occurs most often in children between 2 and 6 years of age. It can occur in any season. Unlike croup, which progresses over a period of days, the course is rapid and progressive (airway obstruction can occur in a period of hours). Epiglottitis is a life-threatening medical emergency.

Signs and Symptoms
The child with epiglottitis appears acutely ill with a sudden sore throat, high fever, drooling, muffled voice, and rapid respirations with difficulty breathing. Stridor is a late, ominous sign with epiglottitis. Nearly complete airway obstruction is most likely occurring if stridor is heard. The child with epiglottitis prefers to sit upright, leaning forward with the chin up and mouth open while leaning on the arms (tripod position or sniffing position). Blood gases fluctuate, and there is leukocytosis. Bacteremia is often present.

Nursing Brief
If epiglottitis is suspected, do not examine the pharynx (back of the throat) because laryngospasm may occur and resulting in obstruction, which can cause respiratory arrest.

Treatment and Nursing Care
It is important for the nurse to display a calm, soothing, and reassuring attitude toward the child while being alert for respiratory complications. Endotracheal intubation equipment must be readily available. Epiglottitis may require endotracheal intubation to maintain the airway. Occasionally, a tracheostomy may be necessary. Children who have been intubated are cared for in an intensive care unit. The child generally receives oxygen, IV therapy, and antimicrobials. The incidence of epiglottitis has decreased since H. influenzae type b vaccine has been administered routinely beginning at 2 months of age.

BRONCHITIS
Bronchitis refers to bronchial inflammation. The bronchi are the two lower divisions of the trachea that branch...
### Nursing Care Plan 11-2  The Child with Asthma

#### Nursing Diagnosis: Gas exchange, impaired, related to increasing airway obstruction from inflammation and mucus

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child shows adequate gas exchange, as evidenced by:</td>
<td>Provide short-acting ( \beta_2 )-agonist (SABA) bronchodilators and other medications as ordered; monitor for effects and side effects. Monitor vital signs and oxygen saturation closely (at least every 2 to 4 hours) for signs of increased respiratory distress. Maintain oxygen saturation between 92% and 95%.</td>
<td>Relax bronchial tissue and open up the airway. Cromolyn prevents late allergic response; steroids reduce inflammation. Close monitoring allows rapid recognition of respiratory distress.</td>
</tr>
<tr>
<td>- Pink skin color</td>
<td></td>
<td>Side effects of some of the medication include tachycardia.</td>
</tr>
<tr>
<td>- Age-appropriate respiratory rate and rhythm</td>
<td>Place child on a cardiac monitor according to hospital protocol.</td>
<td>FACilitates adequate oxygenation in the lung.</td>
</tr>
<tr>
<td>- Ability to talk and sleep comfortably</td>
<td>Provide humidified oxygen as ordered via least stressful route.</td>
<td></td>
</tr>
<tr>
<td>- Absence of wheezing, cough</td>
<td>Provide humidified oxygen as ordered.</td>
<td>FACilitates lung expansion.</td>
</tr>
<tr>
<td></td>
<td>Place child in upright position. Organize care to provide maximum rest periods.</td>
<td>Decreased energy expenditure decreases need for oxygen. Relaxation decreases stress and respiratory effort.</td>
</tr>
<tr>
<td></td>
<td>Encourage relaxation strategies such as slow, deep, breathing; listening to quiet music or stories. Rock the infant or young child.</td>
<td></td>
</tr>
</tbody>
</table>

#### Nursing Diagnosis: Fluid volume, risk for deficient, related to fluid loss from increased expirations and diaphoresis

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child maintains adequate hydration, as evidenced by:</td>
<td>Provide intravenous fluids as ordered. Give clear oral fluids when respiratory effort decreases; give fluids child likes. Avoid cold fluids. Give small, frequent sips rather than larger amounts; use straws, “sippy” cups, or other devices that interest the child. Monitor intake and output.</td>
<td>Maintains fluid balance while the child may be unable to take oral fluids. Providing fluids child likes increases child’s interest in taking them. Can cause bronchospasm. Giving large volumes of fluid can result in vomiting when the child coughs; large volumes also cause distention, which limits diaphragm movement. Provides data on hydration status.</td>
</tr>
<tr>
<td>- Supple skin turgor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Adequate urination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Absence of thirst</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Moist mucous membranes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Nursing Diagnosis: Coping, ineffective, related to stress of acute and chronic illness

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child has decreased stress:</td>
<td>Encourage regular participation in exercise. Advise child to participate in exercise or sports that require short periods of energy (sprints, baseball, gymnastics) or in swimming. Advise child to find enjoyable activities that reduce stress (e.g., bike riding, talking to friends, playing games). Advise parents to encourage child to participate in normal developmental activities.</td>
<td>Exercise releases hormones that facilitate a feeling of well-being. Short bursts of energy allow the child to recover in between; swimming provides external source of moisture for airways. Reducing stress helps the child cope with daily living. Overprotection increases stress by decreasing the child’s self-esteem.</td>
</tr>
<tr>
<td>- Appears calm and in control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Demonstrates stress-reducing measures</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**NURSING DIAGNOSIS** Deficient knowledge about home management, related to inexperience with equipment, medications, and principles of disease management

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent and older child appropriately manage condition at home:</td>
<td>Review teaching about MDI, nebulizer equipment, and PEFR measurements.</td>
<td>Review reinforces teaching.</td>
</tr>
<tr>
<td>• Demonstrate equipment</td>
<td>Have child and parent demonstrate use of equipment.</td>
<td>Return demonstration allows for evaluation of learning.</td>
</tr>
<tr>
<td>• Describe signs indicating condition is worse</td>
<td>Review medications and when to use them. Provide list of criteria for when it is</td>
<td>Reinforces teaching.</td>
</tr>
<tr>
<td>• Intervene appropriately</td>
<td>necessary to adjust medications or call the doctor.</td>
<td></td>
</tr>
<tr>
<td>• Describe principles of infection prevention</td>
<td>Help parents with environmental control measures (e.g., allergy-proofing the home,</td>
<td>Reducing home allergens can reduce episodes in children with allergic asthma.</td>
</tr>
<tr>
<td></td>
<td>installing air purification systems or dehumidifiers to reduce mites and molds).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teach prevention of respiratory infections, avoiding exposure to colds, meticulous</td>
<td>Preventing respiratory infection reduces exacerbations of asthma.</td>
</tr>
<tr>
<td></td>
<td>cleaning of inhalation equipment, yearly influenza vaccine.</td>
<td></td>
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</tbody>
</table>

**NURSING DIAGNOSIS** Interrupted family processes, related to chronic condition and frequent exacerbations

<table>
<thead>
<tr>
<th>Goals/Outcome Criteria</th>
<th>Nursing Interventions</th>
<th>Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family adjusts to child’s chronic illness, as evidenced by:</td>
<td>Encourage parent to participate in child’s care during exacerbations.</td>
<td>Involving the parent decreases parental and child stress.</td>
</tr>
<tr>
<td>• Appropriate intervention during acute episodes</td>
<td>Keep parent informed about changes in condition.</td>
<td>Parents know more about how their child reacts to situations than the health care personnel.</td>
</tr>
<tr>
<td>• Child’s normal development</td>
<td>Maintain child’s usual routine and usual treatment regimen if possible.</td>
<td>Decreases stress associated with hospitalization and increases coping.</td>
</tr>
<tr>
<td>• Absence of inappropriate anxiety</td>
<td>Encourage close communication between family and the school nurse.</td>
<td>Appropriate communication increases consistency in care.</td>
</tr>
<tr>
<td></td>
<td>Listen to family concerns.</td>
<td>Listening provides a basis for planning.</td>
</tr>
<tr>
<td></td>
<td>Refer for financial or psychological help if indicated.</td>
<td>Stress adversely affects family relationships and coping.</td>
</tr>
</tbody>
</table>

**Critical Thinking Snapshot**

A 12-year-old comes to the community health clinic with his mother. He is wheezing and short of breath; his chest is tight, and he is coughing. He is lethargic and sitting in a tripod position. His color is pale, and his skin is cool and clammy. As the nurse, what is your initial assessment of this child? What are your initial interventions? What changes in his breath sounds would concern you?
off to the lungs. This condition is usually preceded by a viral upper respiratory tract infection. It is more common in winter.

The child may initially have a cold followed by a cough that may or may not be productive. Low-grade fever may be present. Crackles and wheezes may be detected on auscultation. As with all respiratory disorders, fluids are important. Bronchitis is generally self-limiting and resolves in 2 to 3 weeks. Antimicrobials, cough suppressants, antihistamines, and expectorants are not indicated (Kliegman et al., 2007).

**PNEUMONIA**

Pneumonia is an infection of the lower respiratory tract in which the alveoli (air sacs) become filled with exudate. As the infection progresses, the exudate becomes solidified (consolidation). The affected portion of the lung does not receive enough air. Breathing is shallow. As a result, the bloodstream is denied sufficient oxygen. *Pneumonitis* is a general term for lung inflammation and may or may not be associated with consolidation.

About 80% of pneumonia is caused by viruses and 20% by bacteria. Aspiration of foreign substances such as talcum powder, peanuts, or popcorn may result in pneumonia. Aspirated hydrocarbons (kerosene, furniture polish, paint thinner) damage the lung cells by impairing the surface tension. Gastroesophageal reflux may result in the aspiration of gastric contents, resulting in pneumonia.
Viral pneumonia can be caused by RSV, influenza, and adenovirus. This occurs more frequently during the winter months. Bacterial pneumonia generally causes a more severe infection. The common bacterial organisms are *S. pneumoniae*, group A streptococcal, *Staphylococcus aureus*, and *H. influenzae*. Additional agents may cause pneumonia such as acute respiratory syndrome (SARS), Avian flu or bird flu (influenza A, H5N1), and the recent outbreak of H1N1 or swine flu.

Pneumonia might occur as the initial or primary disease, or it can complicate another illness, in which case it is termed secondary pneumonia. Secondary pneumonia may accompany various communicable diseases or may follow surgery. It is more serious than primary pneumonia because the child is in a weakened condition.

**Signs and Symptoms**
The symptoms of pneumonia vary with the age of the child and the causative organism. They may develop suddenly or be preceded by an upper respiratory tract infection. The cough is dry at first but gradually becomes productive. Fever rises as high as 103°F to 104°F (39.5°C to 40°C) and may fluctuate widely over a 24-hour period. The respiration rate may increase to 40 to 80 breaths per minute in infants, and in older children to 30 to 50 breaths per minute. Rhonchi and faint crackles may be heard with breath sounds. Respirations are shallow as the child attempts to reduce the chest pain. Sternal retraction may be seen as the assisting muscles of respiration are brought into use. Flaring of the nostrils may appear. The child’s color may vary from pale to cyanotic. The child is listless and has a poor appetite. The child tends to lie on the affected side.

**Treatment and Nursing Care**
The child is given a complete physical examination. A tuberculosis skin test is administered if the child is at risk or if the child has not been tested recently. The doctor pays particular attention to the examination of the child’s chest. Radiographs confirm the diagnosis and determine whether there are complications. A differential white blood cell count is routinely done. Blood specimens show a marked increase in the number of white blood cells (16,000 to 40,000/mm³). The number of red blood cells and the amount of hemoglobin may be slightly reduced. Obtaining blood specimens can be traumatic to the child, and crying can increase coughing spells. The nurse or parent should hug and calm the child afterward.

Treatment depends on the severity of the disease and the causative organism. Children who are in severe respiratory distress, dehydrated, vomiting, or are immunocompromised are treated in the hospital. Bacterial pneumonia is treated with antimicrobials. Treatment for viral pneumonia is supportive. The nurse checks the vital signs at regular intervals. When a child is flushed with fever, remove heavy clothing and blankets and administer antipyretics. The nurse may be asked to give the child tepid sponge baths to help reduce a high fever (see Chapter 3). Oxygen is administered for dyspnea or cyanosis and needs to be monitored with pulse oximetry (Figure 11-10). Rest and conservation of energy are an important part of the treatment of this disease. The nurse needs to organize work so that the child is not disturbed unnecessarily. An increase in fluid intake is important. Encouraging children to increase oral fluid intake is often a goal. Besides water, offer the child Gatorade, juice, or a Popsicle, depending on preference. IV fluids are administered if the child cannot retain fluids because of vomiting or will not take fluids by mouth. They are also given to replace insensible fluid loss from tachypnea and fever. The appetite of the child improves as the condition does. For severe cases that do not resolve, a thoracentesis (surgical removal of fluids using large
Reposition the child frequently. Although this is painful, it is paramount to total recovery. The child probably prefers the affected side (if pneumonia is unilateral) because it splints the chest on that side and therefore decreases the discomfort. Administer prescribed analgesics to increase the child’s comfort. The nurse assists and encourages the child to walk about the room and in the hallways when such activity is prescribed. Small children can exercise their lungs by blowing bubbles through a straw. The respiratory therapist may provide chest percussion and postural drainage exercise.

Although recovery from uncomplicated pneumonia is dramatic today, recuperation takes time. When the child is discharged from the hospital, parents should receive written instructions concerning diet, activity, medication, return appointments, and so on. It is helpful if the parents repeat these instructions to the nurse to determine whether they have interpreted them correctly.

**TUBERCULOSIS**

Tuberculosis (TB) has been around for a long time. There has been an increase in the incidence of this disease. Several factors contributing to this increase are emigration, HIV, and resistant strains. Pediatric TB directly correlates to the incidence of adult TB in the community. A child with TB is usually considered a primary infection and has been infected by contact with an infectious adult or adolescent (Robinson and El-Sadr, 2006).

Tuberculosis is caused by the acid-fast bacillus, *Mycobacterium tuberculosis*. Transmission of the organism is by inhalation of an infected droplet. It begins to multiply in the lung tissue. If the primary lesion erodes into a blood vessel, dissemination of the organism can occur. When the organism spreads to other tissue, such as bone, kidney, or the brain, the condition is known as miliary tuberculosis.

Skin testing is the method of screening for TB. The most accurate form of skin testing is the Mantoux test, which is administered intradermally. The test should be read only by qualified medical personnel. It is recommended that children be screened at 15 months of age. If other risk factors are present, additional screenings may be needed.

Children are most vulnerable to TB when their immune system is the least mature, which is during the first 3 years of life. Another period of vulnerability is just before, during, and after puberty. The risk of becoming infected with TB increases with poverty and crowded living conditions, which can lead to poor hygiene. The highest incidence of TB is among the Hispanic population. Asians represent the second largest ethnic group. Both of these groups who are foreign-born account for 59% of cases. Children’s rates have decreased, but they still continue to be high risk especially if they are from these two groups and are foreign-born (CDC, 2009).

While there is a decrease in the number of cases, another major concern is the developing number of resistant strains. Individuals with HIV are susceptible to TB and should be screened for the exposure. Children with TB should also be tested for HIV.

**Signs and Symptoms**

Diagnosis is determined with tests including a positive skin test. Chest radiographs can confirm the disease. Gastric washing is done to confirm the presence of the bacillus. Infants and small children may present with a nonproductive cough and mild dyspnea. There also may be a failure to thrive. Symptoms may be variable and can include fever, anorexia, malaise, weight loss, night sweats, and mild dyspnea. As the lungs become more invaded, more respiratory symptoms may develop, such as increased respiratory rate, diminished breath sounds, and rales.

**Treatment**

Hospitalization is not necessary except for diagnostic procedures. All hospitalized children with active TB must be in respiratory isolation. All health care workers must wear an N-95 respirator when caring for a child with contagious TB (AAP, 2000). All other treatment can be given in a community-based environment and involves nurses in the ambulatory setting, the school, and the public health facilities.

Gastric washing is done to isolate the bacillus. Young children swallow their secretions, and the organism can be obtained from the stomach. The gastric washing is obtained in the early morning after the child has had nothing to eat during the night. A nasogastric (NG) tube is passed, and the stomach is lavaged. The gastric contents are removed and sent to the laboratory for testing.

Currently the first-line medications given for TB are isoniazid (INH), rifampin, pyrazinamide, and ethambutol. These are given daily for 8 weeks (56 doses) as the initial phase of the preferred regimen. A continuation phase continues for either 4 to 7 months depending on chest film and sputum culture results after the first 2 months. The continuation phase medications typically used are isoniazid and rifampin. Modifications of the regimens can be determined by special circumstances such as HIV and pregnancy (CDC, 2010). Because of the difficulty in eradicating this organism and the importance of compliance, most experts recommend that all drug administration be directly observed (DOT) by a health care worker. A fourth drug such as streptomycin or ethambutol may be added in areas where there are resistant strains.
Asymptomatic TB occurs when there is a positive skin test but all other diagnostic findings are negative. The child with asymptomatic TB is treated with INH for 9 months. Even if they have a negative skin test, children younger than 6 years of age who have been exposed to an adult with infectious TB also receive INH therapy. These children are retested after 3 months. If the skin test is again negative, then the INH therapy can be discontinued. If the skin test is positive, the child needs a complete course of treatment. In rare, severe cases, surgery may be needed to remove the involved tissue.

Nursing Care
Emotional support is vital for this family. The treatment of TB takes a long time. This family’s life will change, and avenues to support them need to be identified.

Tuberculosis is a communicable disease and therefore is reported to the public health department. A concern for some families may be their status as citizens of the United States. This concern can affect the treatment of the disease because a family may not feel that they can be entirely honest with the health care team.

Parents need to know the side effects of the medication(s) given to their child. They need to understand the importance of the length of treatment. In addition, the source of infection needs to be identified so that the disease can be eradicated in the family and in other families in the community. Older children and adolescents can be involved in their own care and should assist in setting goals. Compliance increases if they are active participants.

Because stress can alter the immune system and make it less proficient, decreasing stress for these children is important. Stress may result from many factors, such as fear of bodily harm, fear of being ostracized, fear of peer rejection, being different, or concern that they can give TB to their friends. A support group can be beneficial for these children so that they can verbalize their fears and concerns.

Proper rest and a balanced diet are important for healing. Families may need assistance in regard to a proper diet. Make sure their needs in regard to culture are addressed.

Most affected children limit their own activities. Participation in competitive sports is usually discouraged during this period of time.

Get Ready for the NCLEX® Examination!

Key Points
- Anatomic differences in the respiratory system predispose infants and children to respiratory distress.
- Respiratory distress should be identified early to prevent respiratory failure.
- When interviewing parents of an infant who died of suspected SIDS, avoid implications of guilt.
- Bronchopulmonary dysplasia occurs primarily in premature and low-birth weight infants who have needed mechanical ventilation for a prolonged period of time.
- Children infected with RSV should be placed in contact isolation.
- Aggressive pulmonary therapy, including antimicrobials and intermittent aerosol therapy, has increased the life expectancy of children with CF.
- Bleeding after a tonsillectomy can be identified by frequent swallowing, restlessness, fast thready pulse, and vomiting of bright red blood.
- Eliminating or minimizing environmental triggers can reduce asthma symptoms, disease severity, and the amount of medications needed to have effective asthma control.
- Suspected epiglottitis requires immediate care.
- Infants and children are at greater risk for TB if they are foreign-born Hispanics or Asians.
- Tuberculosis is a communicable disease and should be reported to the public health department. The public health department oversees the management and treatment of this disease.

Additional Learning Resources
Go to your Evolve website (http://evolve.elsevier.com/Price/pediatric/) for the following FREE learning resources:
- 3-D Animations
- Answer Keys
- Appendixes
- Audio Glossary
- Spanish/English Glossary
- Video Clips

Review Questions for the NCLEX® Examination
1. Two clinical features of sudden infant death syndrome (SIDS) that remain constant are: (Select all that apply.)
   1. Child is between 2 and 4 months of age.
   2. Death occurs during winter.
   3. Death occurs during sleep.
   4. Infant does not cry or make other sounds of distress.
   5. Autopsy reveals slight respiratory infection or otitis media.

2. A chronic lung disease that occurs in newborns that are premature or have pulmonary disorders that require mechanical ventilator support with high positive pressure and oxygen is:
   1. Asthma
   2. Cystic fibrosis
   3. Infantile apnea
   4. Bronchopulmonary dysplasia
3. All of the following may be used to achieve pain control with a diagnosis of otitis media **except:**
   1. Acetaminophen
   2. Eardrops (Auralgan)
   3. Warm compresses
   4. Antihistamines

4. An infant is diagnosed with bronchiolitis. Which of the following would be an indication for hospitalization?
   1. Oxygen level of 93%
   2. Respiratory rate of 42 breaths per minute
   3. Fever of 102° Fahrenheit
   4. Inability to tolerate oral feeding

5. It is suspected that a child has cystic fibrosis. The study the nurse would expect to be ordered to diagnose this condition is:
   1. Pulmonary function test
   2. Sweat test
   3. Chest x-ray
   4. Magnetic resonance imaging