CHAPTER 15

Caring for the Child With a Respiratory Condition

CONCEPTS

Oxygenation
Nursing

KEY WORDS

bronchodilator medication
arterial blood gas (ABG) test
pediatric polysomnography (PSG)
polysomnogram
sleep onset latency
sleep stages
sleep efficiency
hyposmia
tonsillectomy
croup
tripod position
steeple sign
status asthmaticus

LEARNING OBJECTIVES

At the completion of this chapter, the student will be able to:

- Describe the anatomy and physiology of the respiratory system.
- Examine common conditions of the respiratory system seen in childhood.
- Prioritize developmentally appropriate and holistic nursing care measures for common pediatric conditions of the respiratory system.
- Explore diagnostic screening, laboratory testing, and medications for common pediatric conditions of the respiratory system.
- Develop teaching plans and discharge criteria for parents whose children have common respiratory conditions.

PICO(T) Questions

The following is an example of a PICO(T) question to consider while reading this chapter:

Do (I) overweight (P) adolescents with asthma (O) have more asthma attacks (C) than adolescents of average weight with asthma?

INTRODUCTION

This chapter provides a review of the anatomy and physiology and developmental aspects of the respiratory system. The discussion includes an examination of the various respiratory conditions including developmentally appropriate and holistic nursing care. Information is given about diagnostic and laboratory testing and medications. Teaching plans and discharge criteria for parents whose children have various respiratory conditions are incorporated.

Respiratory diseases account for about 25% of all pediatric consultations, and 10% of these are for asthma. The other main pediatric respiratory diseases, in terms of incidence, are bronchiolitis, acute bronchitis, and respiratory infections. Respiratory conditions are common causes of illness among children and can be acute, severe, or even life-threatening. Children can experience chronic respiratory illnesses that affect growth and development and overall lifestyle. Pediatric respiratory disorders are responsible for a number of acute and chronic health conditions and are a leading cause of pediatric emergency room visits and hospitalizations (American Academy of Pediatrics, 2018).

ANATOMY AND PHYSIOLOGY REVIEW OF THE RESPIRATORY SYSTEM

The respiratory system (Fig. 15-1) consists of the upper respiratory tract, which comprises the nose, nasal cavity, sinuses, pharynx, larynx, and trachea, and the lower respiratory tract, which includes the lungs, bronchi, bronchioles, and alveoli. The anatomy and physiology of the respiratory system in children differs from that of adults, most obviously in size.

Ventilation (breathing) involves taking in oxygen through the nose and mouth and delivering it to the lungs. The nose has cilia (small hairlike projections) and mucus-producing cells that line the nostrils to prevent small particles from

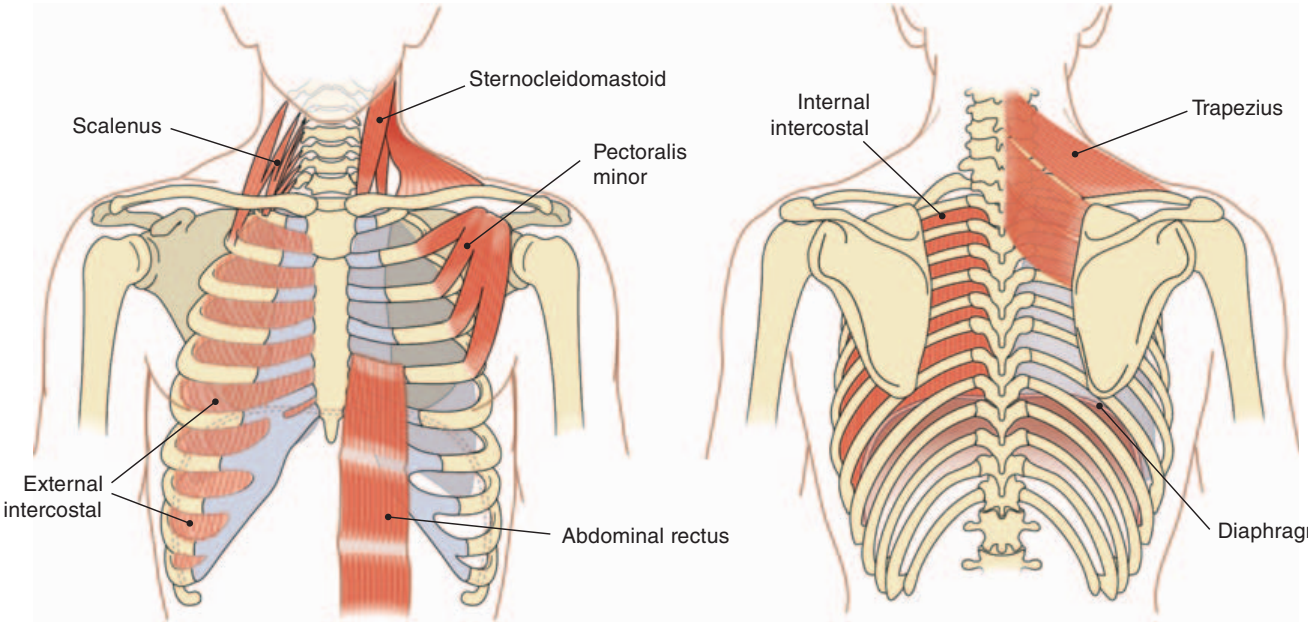

FIGURE 15-1 The respiratory system.

entering the nasal cavity. The mucus is a protective mechanism to trap foreign matter that enters the nasopharyngeal cavities.

Oxygen then passes from the pharynx to the larynx. To prevent food or liquid from entering the larynx, the epiglottis closes over the opening of the larynx during swallowing. A cough reflex expels foreign bodies. From the larynx, air passes through the trachea, which branches into the left and right bronchi. The bronchi divide into smaller branches called bronchioles. The bronchioles end in a cluster of air sacs called the acinus.

Individual air sacs called alveoli exchange oxygen and carbon dioxide. Oxygen exchange with the bloodstream occurs in the capillaries. Oxygen attaches to the red blood cells and is transported to the rest of the body. Carbon dioxide diffuses from the bloodstream into the alveolus where it is transported out of the body during exhalation.

DEVELOPMENTAL ASPECTS OF THE RESPIRATORY SYSTEM

The airway of the newborn is narrow and more easily occluded than that of an adult. Newborns are obligatory nose breathers; they do not use their mouths for breathing. The cough of a newborn is usually nonproductive because young infants produce little respiratory mucus. Because they lack this cleansing function, they are more susceptible to respiratory infections. Newborns have a highly developed sense of smell, and the mucous membranes are highly vascular. The ethmoid and maxillary sinuses are present at birth, though the frontal and sphenoidal sinuses are not fully developed until the child is 6 to 8 years of age. The lymphoid tissues, or tonsils, are absent at birth and grow more rapidly in the child than any other tissue. By age 7, the tonsils present at adult size.

Children younger than the age of 6 are abdominal-breathers instead of thoracic-breathers. The intercostal muscles are too weak to facilitate respiration, causing the child to rely on the use of the diaphragm for inspiration. As the diaphragm moves downward, negative pressure is created, expanding the alveoli and filling the lungs with air. The downward movement of the diaphragm places pressure on the abdominal contents. With increased airway resistance, the weak musculature of the thorax is pulled inward, causing retractions, as if sucking on a collapsed straw.

Growth and Development

Development Considerations for the Child With a Respiratory Condition

The child with a respiratory condition can easily become overwhelmed and burdened with the disease process and extensive medical therapies. For example, cystic fibrosis (CF) is a multisystem respiratory disease that requires extensive medical management to minimize recurrent lung infections. Treatment for CF requires chest physical therapy, exercise regimens, and medications. Additionally, alterations in oxygenation and perfusion can affect the child's ability to participate in physical activity and play. Because of these factors, the child with a respiratory condition is vulnerable to alterations in regular growth and development.

Nursing care of the child with a respiratory condition should maintain a balance of disease symptom management and promotion of regular growth and development. This can be accomplished by providing developmentally appropriate toys that promote oxygenation and the stimulation needed for growth. For example, bubbles and pinwheels engage children in play, promote deep breathing and lung expansion, and assist with development of motor skills and fine motor movement. The nurse should understand the child's abilities and limitations and provide growth and

developmental activities that are appropriate. Activity that supports airway maintenance and adequate oxygenation is essential. The child should be encouraged to participate in activities and allowed to rest as needed. The child with a respiratory condition such as CF and asthma require lifelong medical care and often need frequent hospitalizations. Frequent hospital admissions can result in delays or regression of developmental milestones based on environmental changes and social isolation. The nurse should educate the family about strategies to prevent disease regression and hospital readmission to avoid this.

Retractions are a pulling in of the soft tissue of the chest wall with inspiration and occur when the accessory muscles are used for breathing. This is an abnormal finding and requires the nurse to conduct a more thorough respiratory assessment. In the chest, common sites for retractions include suprasternal, supraclavicular, intercostal, subcostal, and substernal areas.

The respiratory system of the toddler expands to hold a greater volume. This also increases the distances between the structures of the respiratory tract, decreasing the risk of infections. The tonsils and adenoids of the toddler are increasing in size. The eustachian tubes remain short and horizontal during the toddler and preschool-age years, providing easier access for nasal bacteria to enter the ear.

NURSING INSIGHT

Ear Medicine Administration for Toddlers

To administer ear medicine for children younger than 3, place the wrist of the hand you will be using to give the medicine on the child's cheek or head. Place the dropper/nozzle above the child's ear canal. Gently pull the outer flap of the affected ear DOWNWARD and backward to straighten the ear canal.

The epiglottis is long and flaccid among children ages 8 and younger making it more susceptible to swelling that can lead to airway occlusion. The epiglottis is small and does not close properly, and the larynx and the glottis are higher in the younger child's neck, which makes the child more prone to aspiration. The thyroid, cricoid, and tracheal cartilages are immature and easily collapse with flexion of the neck. The child's neck has fewer functional muscles that that of the adult. The increased amount of soft tissue makes the younger child more susceptible to infection and edema.

The trachea in children is shorter and narrower in diameter than in adults. To compare, the trachea of a newborn is approximately 4 mm in diameter, about the diameter of a drinking straw. By age 6, the diameter of the trachea is approximately 12 mm, while an adult's trachea is from 18 to 20 mm in diameter. A child's trachea bifurcates (separates into two branches) at the third thoracic vertebra, but an adult's trachea bifurcates at the sixth thoracic vertebra. In addition to the higher level of bifurcation, the angle of the right bronchus (one of the two large branches of the trachea) is much sharper in children. Because of the narrow lumen of the trachea, excess mucous production can easily produce a greater degree of swelling that can lead to an obstruction and severe respiratory distress.

The right bronchus is shorter, wider, and more vertical than the left; therefore, inhaled foreign bodies more often lodge in the right bronchus. The bronchioles of the infant are little more than a thin layer of muscle elastic-lined with ciliated epithelium. Lung tissue is also immature at birth and continues to develop until about age 12. Children have less alveolar surface for gas exchange than adults. The surface area increases ninefold by age 12. The alveoli increase in number from 25 to 300 million during this time, along with increasing in size and functionality. The maturity of the alveoli enhances ventilation and respiration, promoting more effective gas exchange.

Because of the differences in a child's airway, the force needed for ventilation is greater. Increased friction and resistance make it more difficult to generate ventilation in the presence of airway edema that may result from hypersensitivity reactions or infectious processes.

The average full-term infant has 20 to 50 million alveoli at birth. Rapid growth and maturation of alveoli occurs during the toddler and preschool ages. This expansion improves ventilation; respiratory rates decrease significantly from those of the newborn. The alveoli continue to increase in number during the school-age period, reaching approximately 300 million by 8 years of age. Lung development is complete by 5 to 6 years of age. The respiratory structures of the adolescent are of approximately adult size and capacity.

NURSING INSIGHT

Respiratory Rate

In assessing the respiratory rate of a child, the nurse understands that the rate and depth of respirations can be affected by crying, physical activity, anxiety, anemia, acid-base disturbances, fever, central nervous system disturbances, and salicylate ingestion. The child's respiratory rate is assessed in correlation with other overall physical findings. When assessing the respiratory rate of the pediatric patient, the nurse counts for a full minute (Table 15-1).

TABLE 15-1

Average Respiratory Rates in Children

PRETERM	NEWBORN	1 YEAR	3 YEARS	6 YEARS	10 YEARS	14 YEARS	18 YEARS
40–70	30–50	20–40	20–30	16–22	16–20	14–20	16–20

Source: Kliegman, R. (2020). Nelson textbook of pediatrics (Edition 21). Chapter 121, Respiratory Track Infections. Philadelphia, PA: Elsevier.

What to Say

Assessing a Child's Respiratory System

Always adjust your approach to a pediatric physical examination based on the child's age, developmental and cognitive abilities, and how well or unwell the child appears. In addition, try to take advantage of periods of quiet to listen to lung sounds.

Always introduce yourself to the parents and the child, including your name and role.

Confirm the child's name and date of birth. Briefly explain what the examination will involve using age-appropriate language:

"Hi, my name is Lola, and today I'll be Emily's nurse. I'd like to perform a respiratory examination now, which will involve observing your child's breathing, feeling her pulse, and listening to her breathing with my stethoscope."

Diagnostic Tools

Pulmonary Tests for Pediatric Lung Disorders

Pulmonary tests are an important aspect of diagnosing lung disorders in children. Diagnostic tests used in pediatric pulmonary assessments can include the following:

- Pulmonary function testing (PFT) is a series of breathing tests that measure lung function. PFTs are used to determine how efficiently the lungs take in and exhale air and transfer oxygen to the blood. PFT is usually performed to:
  - Diagnose respiratory conditions
  - Assess lung and airway growth
  - Monitor chronic respiratory conditions
  - Evaluate medication effectiveness
- A spirometry test is the most common pulmonary function test. During a spirometry test, the patient breathes into a mouthpiece, usually while sitting in a special booth called a body plethysmograph. The spirometry test typically requires at least three long blasts of air and takes just a few minutes. Your child may be asked to use a **bronchodilator medication** (Albuterol) after the test and repeat the spirometry test 15 minutes later to assess lung response to the bronchodilator. The mouthpiece is connected to a spirometer that records the amount and rate of air being inhaled and exhaled. Spirometry testing is used to diagnose certain lung conditions, including:
  - Asthma
  - Chronic obstructive pulmonary disease (COPD)
  - Bronchitis
  - Emphysema
  - Pulmonary fibrosis

Pulmonary function can often be evaluated through the body's response to exercise. Depending on the pulmonary condition being tested, your child may be recommended for:

- A 6-minute walk test (simple pulmonary stress test), which measures how far the patient can walk in 6 minutes. At the conclusion of the test, the child rates shortness of breath from 0-10 on a special scale. A finger probe is used to evaluate oxygen levels and heart rate. Slowing down or resting is permitted if necessary.
- Cardiopulmonary exercise test (CPET), a 12- to 15-minute test that measures breathing variations, as well as blood and oxygen flow to the muscles, during exercise. Patient walks on a treadmill or pedals a stationary bicycle while breathing into a mouthpiece. Other monitoring devices measure vital functions as resistance is increased. Monitoring continues while the child rests afterward.
- Exercise-induced asthma challenge, which measures functionality of the lungs before and after exercise. Testing process is similar to CPET but for a shorter time period and with no resistance. Used to identify exercise-induced asthma, set exercise limits, or evaluate the effectiveness of current medications.
- Pulse oximetry, a noninvasive test used for monitoring oxygen saturation in the blood. A sensor device is placed on the patient's body, usually the fingertip, which transmits wavelengths of light that pass through a pulsating capillary bed to a photodetector. The photodetector measures absorbency of the wavelengths to determine blood oxygen levels. Often used overnight to determine whether oxygen levels drop during sleep.

Several radiological imaging studies may be used to diagnose pulmonary conditions or disorders. Common studies used to assess the respiratory system can include:

- Thoracic (chest) imaging, instrumental in diagnosing, as well as evaluating treatment effectiveness in conditions such as asthma, pneumonia, pulmonary embolism, and CF.
  - Chest x-rays (CXR) can help diagnose and monitor certain lung conditions, such as pneumonia or emphysema.
  - Computerized axial tomography (CAT or CT) scan, a combination of special x-ray equipment and computer technology to produce more detailed imaging. The horizontal (axial) images provide a cross-sectional view of the organs. Often used to identify pulmonary embolism.
  - Magnetic Resonating Imaging (MRI), which provides three-dimensional pictures of the organs using a magnetic field and radio wave energy. Can detect problems not seen on CT scans or x-rays without the use of radiation.
  - Ultrasound, which uses high-frequency sound to produce images of what's happening inside of the body in real time. Used to confirm conditions such as pneumonia, pulmonary edema, and pneumothorax.

Oxygen and carbon dioxide monitoring involves attaching electrode-containing sensors to the skin to measure oxygen and carbon dioxide levels in the blood. The electrodes warm the skin, which causes capillary

dilation resulting in an increase in blood flow and oxygen delivery to the skin surface. The sensors are connected to a monitor where the oxygen and carbon dioxide levels are displayed.

Oxygen and carbon dioxide levels may also be measured by performing an **arterial blood gas (ABG) test**. An ABG test uses the blood taken from an artery to measure: Partial pressure of oxygen, partial pressure of carbon dioxide, bicarbonate, pH, oxygen content, and saturation values. ABG testing can identify how efficiently the lungs remove carbon dioxide from the blood and move oxygen into the blood.

A sweat test is the most reliable method for diagnosing CF (Wood et al, 2018). Sweat testing involves measuring the amount of chloride and sodium (salt) present in the patient's sweat. During the sweat test, small electrodes and gauze are placed on the forearm or leg while a special machine stimulates sweating at the area under the electrodes. The gauze absorbs the sweat, which is then analyzed for chloride content. Stimulation is administered in 5-minute increments. Sweat testing is not painful and usually takes approximately 30 minutes. Results of the sweat test are generally available the same day.

Diagnostic Tools

Diagnosing Pediatric Sleep Disorders

Pediatric polysomnography (PSG) is a sleep study test used in diagnosing sleep disorders in children. During polysomnography, information is collected about brain waves, blood oxygen levels, eye and leg movements, respiratory effort or events, and heart rhythm. This test is usually performed by closely monitoring the patient overnight. The information obtained from the **polysomnogram** is analyzed by scoring several variants of sleep including:

- **Sleep onset latency:** Time elapsed from lights out to onset of sleep
- **Sleep stages:** REM (rapid eye movement) sleep, slow wave sleep, and two stages of light sleep
- **Sleep efficiency:** Minutes of sleep divided by minutes in bed, breathing irregularities, oxygen saturation, and cardiac rhythm abnormalities

PSG is beneficial in diagnosing sleep apnea, hypoventilation syndromes, and other sleep-related disorders.

CONGENITAL RESPIRATORY CONDITIONS AND STRUCTURAL ANOMALIES

Children can be affected by various congenital respiratory conditions and structural anomalies that affect health and function. It is essential that the nurse has a good understanding of the presenting signs and symptoms of the diagnosed condition and the prescribed care.

MEDICATION

Medications Used to Treat Respiratory Conditions

Therapeutic Category	Indication(s)	Action(s)
Antibiotics (oral, parenteral, inhalation)	Abscess, bacterial pneumonia, cystic fibrosis, empyema, pharyngitis, sinusitis, tonsillitis, tuberculosis. Inhaled antibiotics are used in cystic fibrosis.	Treats respiratory tract bacterial infections.
Antihistamines (oral)	Allergic rhinitis, asthma.	Counteracts the effects of histamine on a receptor site used to treat allergies, hypersensitive reactions, and colds.
Anticholinergics (inhalation)	Acute or chronic wheezing in asthma or chronic lung disease.	Produces bronchodilation (without systemic effects) and inhibits the muscles from tightening around the bronchi (large airways).
Antiviral agents (oral, parenteral)	Influenza virus types A and B.	Treats the flu symptoms. Antiviral agents do not destroy their target pathogen; instead they inhibit their development.
B_2, Agonists (oral, inhalation)	Asthma, chronic obstructive lung disease.	Acts as a smooth muscle relaxant resulting in bronchodilation.
Caffeine (oral)	Apnea.	Stimulates the respiratory center.
Corticosteroids (oral, parenteral, inhalation)	Asthma.	Acts as a potent anti-inflammatory agent.

Therapeutic Category	Indication(s)	Action(s)
Cough suppressants (oral)	Common cold, bronchitis, pneumonia, sinusitis.	Treats a cough (productive or dry). For a productive cough (with phlegm), the cough syrup contains an expectorant to help loosen mucus. For a dry cough, the cough syrup contains suppressants (antitussives) in an attempt to suppress the urge to cough.
Decongestants (oral)	Common cold.	Reduces swelling and congestion.
Expectorants (oral)	Common cold, pneumonia.	Reduces viscosity of thick mucus secretions.
Leukotriene receptor antagonists (inhalation)	Asthma, bronchitis, constricted airways.	Inhibits leukotrienes that cause inflammation.
Mast-cell stabilizers (inhalation)	Asthma (maintenance).	Prevents or controls certain allergic disorders.
Recombinant human deoxyribonuclease I (rhDNase) (inhalation)	Cystic fibrosis.	Helps delay cystic fibrosis progression by improving lung function and reducing the risk for respiratory tract infections and thins and loosens mucus.
Racemic epinephrine (inhalation)	Croup, bronchiolitis.	Produces bronchodilation.
RSV vaccine (IM injection)	Respiratory syncytial virus.	Provides infection-fighting antibodies to help protect high-risk infants' vulnerable lungs.

Source: Wood et al. (2018).

Esophageal Atresia (EA) and Tracheoesophageal Fistula (TEF)

EA is the failure of the esophagus to develop a continuous passage characterized by the presence of a blind pouch. The proximal and/or distal portions of the esophagus may or may not be connected to the trachea by a fistula (TEF). A TEF creates an abnormal communication between the trachea and the esophagus. The defect occurs in approximately 1 in 3,000 live births and is commonly associated with polyhydramnios (the presence of excess amniotic fluid in the amniotic sac) and cardiac defects (Baird et al., 2019). TEF is often associated with other anomalies, which may involve the kidneys, heart, limbs, or spine.

This anomaly occurs during fetal development when the tracheoesophageal groove fails to close, resulting in incomplete separation of the trachea and esophagus. The esophagus and trachea begin forming from the foregut in the 4- to 6-week-old embryo. During this process of formation, the posterior deviation of the tracheoesophageal septum leads to failure of closure between the trachea and esophagus (Fig. 15-2).

Signs and Symptoms

EA and TEF may manifest with:

- Excessive drooling and secretions
- Frothing and bubbling at the mouth and nose
- Cyanosis
- Respiratory distress
- Choking with attempted feeding
- Inability to pass orogastric tube into the stomach

Clinical symptoms may intensify with feeding, leading to regurgitation, choking, and aspiration.

In cases of isolated TEF, symptoms may occur later in life, such as chronic respiratory problems and abdominal distention because of air building up in the stomach. Because EA and TEF have been associated with other congenital anomalies that occur in the musculoskeletal, GI, cardiac, and genitourinary systems, a thorough assessment by the nurse is necessary.

Diagnosis

If not diagnosed with prenatal sonogram, most neonates are diagnosed soon after birth or during infancy because TEF is a life-threatening condition. TEF is confirmed by observing an early onset of respiratory distress accompanied by signs and symptoms described earlier, as well as possibly the inability to pass a nasogastric or orogastric tube. Confirmatory diagnosis is made through radiography. Chest films are taken to determine the patency of the esophagus or the presence and level of the blind pouch.

NURSING INSIGHT

Nursing Assessment

When assessing a child diagnosed with EA or TEF, the nurse watches for subtle changes in the child's color, respiration, behavior, heart rate, and general health. Subtle changes often occur before technology can recognize these changes. It is essential to have emergency equipment ready at the bedside. It is also important to remember that the child has an uncanny ability to compensate. When the child is no longer able to compensate, the child "crashes" and may have a poor probability of recovery.

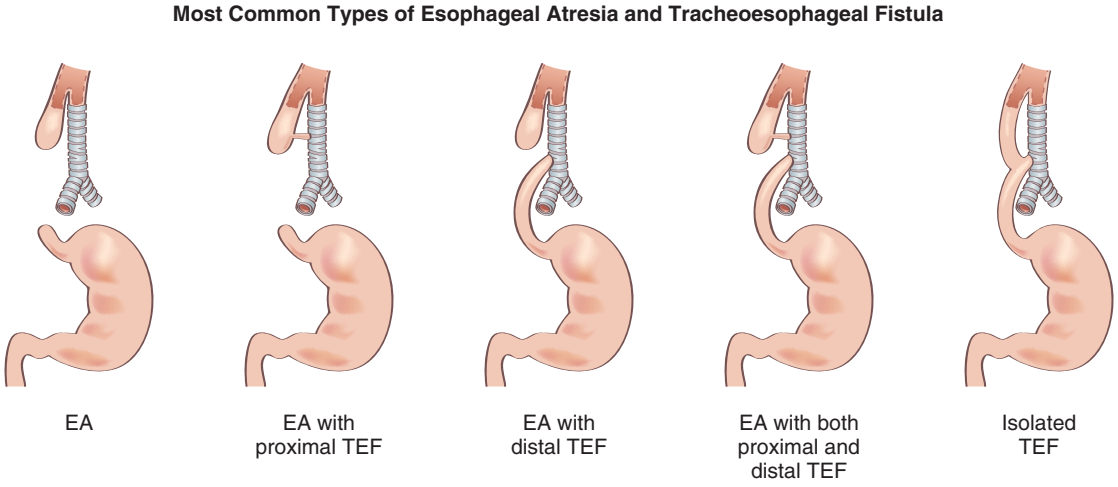

FIGURE 15-2 Esophageal atresia and tracheoesophageal fistula.

Surgical Care

After life-sustaining measures are given, surgical corrections may come in stages as needed for palliative care (e.g., gastrostomy and drainage of esophageal pouch). The goal of surgery is to close the fistula and attach the two sections of the esophagus. Artificial ventilation may be required in the beginning, and the child can be weaned off the artificial ventilation as the condition improves. However, endotracheal (ET) intubation is often avoided because it may worsen abdominal distention because of the connection between the trachea and esophagus (Fig. 15-3).

Before surgical correction, the neonate is not given oral feedings, but IV (parenteral) fluids. The nurse positions the neonate at a 30- to 45-degree elevation of the head to protect the trachea from secretions, and the head is turned to the side to prevent aspiration and drain secretions. Suctioning is done regularly and at frequent intervals. A nasogastric or orogastric tube with continuous, low suctioning is likely to be placed by the health-care provider into the blind pouch and monitored for patency. The tube should not be irrigated because this may cause aspiration. Hydration and fluid and electrolyte balance are monitored. Often, antibiotic therapy is started because aspiration pneumonia is inevitable.

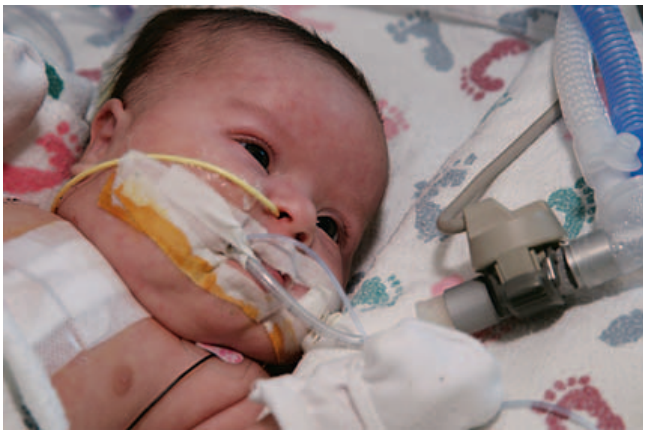

FIGURE 15-3 Child with an endotracheal tube.

FOCUS ON SAFETY

Preoperative and Postoperative Suctioning

Preoperatively, any nasogastric or orogastric tube placement for suctioning must be done carefully and gently. Stop progression immediately if any resistance is met because this can lead to a perforation of esophageal tissue in an infant with an anomaly. Tube placement is usually done by the primary care provider. Postoperative oral or nasal suctioning of the infant with EA or TEF must also be done extremely carefully to avoid disruption of the repairs. Carefully measure the catheter and do not insert any further than the distance from the nares to the ear lobe.

Immediately after the surgical correction, nurses must monitor vital signs at regular intervals. The site requiring correction is usually in the thoracic cavity, so the nurse expects the baby to return with a chest tube and possibly still be intubated with an ET tube. Infants with chest tubes are carefully handled to avoid dislodging the tube. Suctioning of the oropharyngeal area is kept to a minimum to avoid disruption of the surgical repair.

Postoperatively, the nurse performs vigilant assessments on all body systems to detect any complications or new problems. Because the child may have low blood counts and a decrease in fluid volume, the nurse must regulate plasma or blood transfusion and the IV infusions adequately. To maintain adequate nutrition, gavage feeding may be initiated by the second or third postoperative day. Gavage feedings are administered slowly while watching the child closely for any untoward manifestations, such as aspiration. The child requires prolonged hospitalization, so the family must be informed about the lengthy hospital stay and the need for ongoing treatments. After the child has recovered, he or she may be discharged to the care of the parents. Emphasize to the family the need for frequent follow-up visits to ensure that no complications or problems are present.

Chest Tubes

Removal of air, fluid, or blood from the pleural, pericardial, or mediastinal spaces may be facilitated by the placement of

chest tubes. The purpose of closed chest suction is to remove air and fluid from the thoracic cavity and to improve postoperative lung reexpansion, as well as to treat pneumothorax. The chest tube is connected to a closed drainage system. The closed drainage systems consist of an underwater seal, a collection chamber, and suction chamber in a single unit, which is subsequently connected to sterile tubing and a suction device. Suction is applied as prescribed by the primary care provider and typically ordered at −15 to −20 cm H_2O. To function properly, the chest drainage system needs to be placed a minimum of 1 foot (30 cm) below the level of the lungs.

NURSING CONSIDERATIONS

- Explain procedure to the child and parents.
- Note character, consistency, and amount of drainage in the collection chamber.
- Note integrity of the tubing and chest tubes every 2 to 4 hours.
- Carefully coil the tubing and secure to the edge of the bed, avoiding pressure or kinks in the tubing.
- Mark drainage level according to the policy of your institution.
- Never clamp the tube when moving or transporting the child.
- Encourage coughing and deep breathing according to the policy of your institution.
- Check the rate and quality of respirations and auscultate the lungs according to the policy of your institution.
- Instruct the child and parents to report any breathing difficulty.
- Notify the primary care provider of changes in color, decreased oxygen saturation, rapid or shallow breathing, chest pain, or excessive bleeding.
- Check the chest tube dressing according to the policy of your institution.
- Do not routinely milk or strip the chest tubes because it can cause negative pressure, which may damage lung tissue.
- Document observations, routine care, dressing appearance, drainage, and functioning of the chest drainage system according to your institution's policy.

Education/Discharge Instructions

After corrective surgery, most affected infants lead normal lives. The potential for postoperative infection can be prevented by instructing the parents to keep the wound clean and dry. Instruct the parents on carefully observing the infant during feeding and reporting any difficulty swallowing. Parents also need to be instructed on proper feeding and positioning to avoid aspiration. In addition, parents must be educated on signs of respiratory infection, as well as on the signs of a stricture, which may be demonstrated by refusal to eat and can require dilation. If complications do occur, they are challenging, especially during infancy. Prognosis depends on the presence or absence of other associated anomalies.

Acute Respiratory Distress Syndrome (ARDS)

ARDS is a life-threatening condition characterized by increased pulmonary capillary permeability and pulmonary edema, which leads to hypoxemia, reduced lung compliance, and alveolar infiltrates (Khemani et al, 2019). An acute underlying illness or injury such as sepsis, viral pneumonia, smoke inhalation, aspiration of gastric contents, hydrocarbon ingestion or aspiration, or near-drowning may progress to ARDS. Infection is the most common cause, often associated with respiratory syncytial virus (RSV) in children. Indirect lung injury, such as with pancreatitis, shock, burns, trauma, drug overdoses, and blood transfusions, may also precipitate ARDS. The underlying disease or disorder influences the mortality rate. Mortality in adults can be as high as 90% with underlying liver disease and as low as 10% in children with RSV. The average mortality rate overall is 40%. Multisystem organ failure is a frequent complication of ARDS, has a major effect on the prognosis, and is the leading cause of death in both adults and children.

As the disease progresses, the alveolar-capillary membrane becomes more permeable. As exudate enters the alveolar spaces, the lung becomes less compliant and susceptible to pulmonary edema. This further leads to decreased surfactant production, which exacerbates alveolar instability. Swelling leads to atelectasis, and gas diffusion is impaired (Burns & Dunn, 2020). As a result, decreased oxygen enters the bloodstream, which may lead to multisystem organ damage.

Patient Education

Care for the Child With Esophageal Atresia and/or Tracheoesophageal Fistula

The nurse prepares the parents/caregivers for discharge and home management. The nurse must teach parents these topics at discharge to home care for the child who has a diagnosis of EA and/or TEF:

- In the case of tracheotomy, teach parents proper sterile technique of suctioning and how to handle the equipment appropriately.
- Verify that all emergency numbers are written down in a prominent place so parents can reach out for emergency care if necessary.
- Ensure parents know how to identify respiratory distress.
- Confirm parents know feeding techniques for gastrostomy tube and how to handle tube plugging and dislodging.
- Instruct parents in performing CPR before the child goes home.
- Encourage parents to use different toys and games to promote stimulation during regular care (e.g., encourage mobilization or action play to help the child reach developmental milestones and divert the child's mind, which may help the child cope during the prolonged sickness). Mobilization can be as simple as holding or rocking, while action play can be games, toy figures, or crafts.
- Involve other siblings in adapting the young child with EA or TEF. It is essential that the family help the child with EA or TEF learn socialization and interaction with others.
- Ensure the family knows how to operate equipment and proper maintenance of the equipment used at home.

Signs and Symptoms

Respiratory distress results when breathing does not match the body's metabolic demand for oxygen due to failure of oxygenation and/or ventilation. Respiratory distress is typically characterized by signs of increased work of breathing, such as tachypnea, use of accessory muscles, and/or retractions. Head bobbing, nasal flaring and grunting are additional signs more commonly seen in very young children. A respiratory rate that is inappropriately slow for the clinical condition may also be a sign of respiratory distress and may be more important than impending respiratory arrest. An abnormal pattern of respiration is a sign of respiratory distress that may offer clues to etiology.

ARDS is usually diagnosed in a patient who is in the hospital from a critical illness such as shock, sepsis, or other trauma. Diagnostic tests may include:

- Arterial blood gases
- Chest x-ray
- Other blood tests that can find an infection that may be causing ARDS
- CT scan of the lung
- Electrocardiogram and echocardiogram to rule out cardiac causes

Prevention

The incidence of ARDS may be decreased through primary prevention of traumatic injuries by use of child car restraints, bicycle helmets, and protective sports gear. Some infectious illnesses primarily affecting the respiratory tract may be prevented through compliance with recommended immunizations and good hand washing hygiene. RSV passive immunization with immunoglobulins can inhibit more serious illness in vulnerable patients.

Collaborative Care

NURSING CARE

Caring for children with ARDS requires advanced training and technical skills along with vigilant nursing assessment and monitoring of vital signs. The nurse must accurately record and report significant changes in vital signs to the physician. Calories and fluids are provided intravenously; therefore, the nurse monitors exact intake and output. In addition, the child with ARDS requires supportive care. The child will be placed in intensive care, and both the respiratory and cardiovascular status will be monitored closely. Care includes positioning, pain and anxiety control, maintenance of nutrition, and infection control practices. Ventilator support may be required as the disease progresses and requires the nurse to be sensitive to the psychological support of both the child and family. Education should include an explanation of procedures and assisting the family to understand test results and evidence of disease progress.

MEDICAL CARE

Medical management is directed at improving oxygenation and ventilation and often includes the use of mechanical ventilation with attention to positive end-expiratory pressure (PEEP). Monitoring includes continuous blood pressure measurements, central venous pressure monitoring, and ABS analysis to assess for adequate oxygenation, ventilation, fluid volume, and cardiac functioning. Fluids may be restricted to reduce intravascular volume because of the potential for pulmonary edema related to increased pulmonary capillary permeability.

Most people with ARDS will need mechanical ventilator assistance with a low tidal volume. Use of a high tidal volume can overdistend the lungs, leading to lung inflammation and ventilator-associated lung injury. For milder symptoms, oxygen may be delivered using a properly fitting face mask. PEEP is considered an essential component of ventilation. Use of PEEP helps expand alveoli and increases lung volume.

Prone positioning has been demonstrated to improve postural drainage and ventilation of collapsed portions of the lungs. Use of inhaled nitric oxide, which causes pulmonary vasodilation increasing blood flow, has been found to improve oxygenation, though research has not demonstrated an overall significant improvement in survival rates. Surfactant therapy has been studied as a potential treatment for ARDS, though consistent benefits in children have not been identified. Use of extracorporeal membrane oxygenation (ECMO), which removes the blood from the body and then returns it, has also been used in adults, though according to Cheifetz (2011), limited data addresses its use in children. Though ECMO is a life-saving therapy, it is also considered invasive with a high risk of bleeding.

Education/Discharge Instructions

Parents need to be instructed about the need for that long-term care follow-up and monitoring of the pulmonary system. In addition, parents need to understand the importance of maintaining a smoke-free environment, providing proper nutrition, avoiding infections, and ensuring compliance with immunizations.

Cystic Fibrosis

Cystic fibrosis (CF) is an inherited autosomal-recessive disorder of the exocrine glands that causes the production of thick mucus that affects several body systems, including respiratory, gastrointestinal (GI), and reproductive. CF is the most common cause of chronic respiratory disease in children and is accompanied by multiple, severe respiratory infections. CF is the most common autosomal recessive disease in the Caucasian population, occurring in approximately 1/3,500 births (Wood et al, 2019). The increased mucus production in the airways causes obstruction and stasis of fluid, providing a rich habitat for bacterial growth. In addition, the pancreatic ducts are often blocked by mucus, prohibiting the secretions of pancreatic enzymes necessary for the metabolism of food nutrients. In later childhood, the reproductive system is affected because ovarian ducts and the vas deferens may be occluded, leading to infertility. An increased loss of sodium causes salt depletion in children with CF.

Most patients become symptomatic at birth or soon after birth. Respiratory infections and poor weight gain are the most frequent presentation. These symptoms coupled with pancreatic insufficiency usually signify a diagnosis of CF. Other classic disease manifestations are excessive salt loss via sweat and male infertility. Respiratory disease is the most severe manifestation and the most frequent cause of death or lung transplant in early adult life. While CF is part of the normal newborn screening tests in the U.S., it can be sometimes missed. If CF is suspected, a sweat

chloride test is performed; a sweat chloride concentration above 60 mmol/L is diagnostic for CF.

Prevalent CF pathogens leading to chronic lower lung infections include *Staphylococcus aureus* and *Pseudomonas aeruginosa;* while later in the disease course, some patients become infected with more unusual and difficult to treat pathogens like *Burkholderia cepacia Achromobacter xylosoxidans, Stenotrophomonas maltophilia,* and mycobacteria (Wood et al., 2019). However, complications can occur in nearly every organ and increase with age, including liver disease, CF?related diabetes, nasal polyps, and intestinal obstructions.

CF is transmitted as an autosomal-recessive trait, which means that a child can receive a defective gene from either parent. When both parents carry the defective gene, the child has a 75% chance of inheriting one CF gene from each parent and manifesting the disease. There is a 50% chance that the child will inherit one defective gene and one normal gene from each parent and become a carrier of the disease. There is a 25% chance that the child will inherit only normal genes and be free of CF.

The CF genes have been found on chromosome 7, which encodes CF transmembrane conductor regulator (CFTR) protein. CFTR normally regulates the chloride channel and facilitates the activity of other chloride and sodium channels at the cell surface. Abnormal functions of CFTR cause a disruption of sodium ion transport across the exocrine and epithelial gland cells and make the cell walls impermeable to chloride ions. This causes an excess of sodium and chloride found in the sweat of children affected by CF. In addition, the loss of sodium and water from the airways increases the viscosity of the mucus and disrupts the ciliary mechanism (hairlike process) that is intended to clear the airways, predisposing the child to recurrent respiratory infections.

A similar transport defect occurs in the pancreatic and bile ducts. With inadequate excretion of pancreatic enzymes for food breakdown, children experience varying levels of protein and fat absorption. Reduced protein and fat absorption leads to weight loss and failure to thrive, requiring an affected child's diet to be high in protein and calories. Fat is excreted in the stool, resulting in abnormal bowel patterns, including steatorrhea, diarrhea, and abdominal pain.

The mucus gland produces thin, free-flowing secretions, but in CF it produces thick mucus that accumulates and obstructs organs. In newborns, thick secretions may plug the small intestine and lead to failure in passing meconium (the first feces of a newborn infant, which is greenish black, odorless, and tarry) (Venes, 2017). In the GI system, thick secretions impair the digestive system and lead to malnutrition in childhood.

Signs and Symptoms

CF affects the vital organs of the body, and children with the condition show a wide range of signs and symptoms. The severity of the symptoms also varies. Because CF is a multisystem disease (failure of two or more organ systems), the symptoms are presented according to the body system affected.

Gastrointestinal tract symptoms include:

- Meconium ileus
- Prolonged jaundice
- Steatorrhea
- Rectal prolapsed

Respiratory symptoms include:

- Crackles
- Wheezes
- Diminished breath sounds
- Productive cough
- Tachypnea, hypoxia, and cyanosis

Integumentary symptoms include:

- Salty-tasting tears and skin

Secondary consequences include:

- Dehydration
- Secondary respiratory infections, namely bacterial pneumonia
- Malnutrition
- Intestinal atresia
- Idiopathic pancreatitis
- Biliary cirrhosis
- Cholestasis
- Emphysema and atelectasis
- Prolonged hypoxia
- Hemoptysis
- Diabetes
- Anemia
- Failure to thrive
- Osteoporosis

Common characteristics include a child who:

- Is thin and underweight (classified as less than or equal to 10th percentile for height and weight on a standardized growth chart)
- Has a barrel chest
- Has a protuberant abdomen and distention
- Has wasted buttocks
- Has thin extremities
- Is listless and lethargic
- Has delayed development of secondary sex characteristics and infertility
- Has occlusion of the vas deferens in males
- Has occlusion of the ovarian ducts in females

Diagnosis

The diagnosis of CF is based on the child's signs and symptoms, including a positive family history of the disease, absence of pancreatic enzymes, increase in the electrolyte concentration of sweat, and chronic pulmonary involvement. Chest x-ray films show patchy atelectasis and obstructive emphysema. A quantitative sweat chloride test is performed on sweat obtained by iontophoresis of pilocarpine. The results of the sweat chloride test are determined differently depending on the age of the child.

Prevention

CF is currently not preventable. In families with a known history of CF, identification of carriers may assist the parents in family planning decisions.

Collaborative Care

NURSING CARE

The goal of treatment is to ensure respiratory function, enhance nutrition, promote growth and development, and encourage independence in an individual child and family. The potential for the complications related to respiratory

infection and malnutrition can be reduced or prevented by instructing the parents on proper nutrition, medication compliance, good hand washing, and avoiding contact with persons with respiratory infections.

MEDICAL CARE

Airway clearance and antibiotic use are the key treatment modalities for lung disease related to CF. Ensuring respiratory function in children entails controlling infection and improving aeration. These care measures are achieved via medicated aerosol therapy, chest physiotherapy (CPT; percussion and postural drainage), and antibiotic therapy (Fig. 15-4). Some children with CF have a central venous access device for frequent antibiotic administration. Evidence-based medications routinely used in the treatment of CF include inhaled mucolytic agents, recombinant human DNAse (Pulmozyme), inhaled hypertonic saline, and medication for chronic pseudomonas infections, which include inhaled tobramycin (TOBI) and oral azithromycin (Baird et al., 2019).

Most children with CF have a complete loss of pancreatic function and inadequate digestion of fats and protein; therefore, replacing pancreatic enzymes is an important aspect of management. Enzyme replacement is administered with meals and snacks, so the digestive enzymes are mixed with food in the duodenum.

Optimizing Outcomes

Nutrition With CF

The best outcome for a child with CF is a well-balanced, high-protein, high-caloric diet. Pancreatic insufficiency results in malabsorption of fat-soluble vitamins (vitamins A, D, E, and K). Daily vitamin supplementation is recommended. The nurse can also work closely with family to prevent infection as well as optimize nutrition and growth of a child.

FIGURE 15-4 Chest physiotherapy is performed to loosen and remove lung secretions. Percussion and vibration are used over the affected areas of the lungs.

Education/Discharge Instructions

It is essential that the nurse teach parents how to care for their child at home. After the diagnosed and acute phase of illness, the family is prepared for home management and assists in promoting child growth and development with limitations.

- Teach the family about the nature of the disease and prepare them to manage day-to-day minor complaints.
- Assist the family in arranging for the portable suction machine and about the proper suctioning technique at home.
- Instruct the family to do the respiratory therapy before a meal because CPT may induce vomiting of thick mucus.
- Teach the family different techniques used for CPT and postural drainage and coughing exercises based on the child's age. The child needs to be suctioned, followed by CPT and inhalation to liquefy the thick secretions.
- Teach the family about preferred meal plans, high-caloric diet, and mixing pancreatic enzyme with meals.
- Instruct the family to monitor the child's weight to ensure proper growth patterns.
- Teach the family how to administer medications properly.
- Inform the family how to access community resources and how to contact their home health nurse.

Nursing Interventions:

1. Wash hands or use approved alcohol-based hand rubs, before and after providing care. Appropriate hand hygiene helps prevent infection outbreaks, reduces transmission of antimicrobial-resistant organisms, and reduces overall infection rates.
2. Monitor temperature every 4 hours. Report a single temperature greater than 101.3°F (38.5°C) or three temperatures greater than 100°F (38°C) in 24 hours to the care provider. Fever is often the first indication of infection.
3. Observe for and report additional signs of infection such as increased mucus production, persistent cough, tachypnea, difficulty breathing, or cyanosis. Increased mucus production in the airways causes obstruction and stasis of fluid, providing a rich habitat for bacterial growth. Early detection of infection allows for prompt and appropriate intervention.
4. Monitor and report laboratory values as ordered, such as complete blood count with differential, serum protein, serum albumin, and cultures. Laboratory values are correlated with the child's history and physical examination to provide a global view of the patient's immune function and nutritional status.
5. Encourage fluid intake and a high-calorie balanced diet, emphasizing proteins, fatty acids, and vitamins. Nutrients benefiting the immune system include essential amino acids, linoleic acid, vitamin A, folic acid, vitamin B_6, vitamin B_{12}, vitamin C, vitamin E, Zn, Cu, Fe, and Se. Efficient immune function may be affected by deficiencies in one or more of these nutrients.
6. Instruct the child and parents on principles of medication management: prophylactic antibiotics,

medicated aerosol therapy, CPT, and deep breathing and cardiovascular exercise. Instruction empowers the child and family to manage care. Medicated aerosol therapy, CPT, and deep breathing exercises help reduce atelectasis and risk for infection and promote healing.

7. Encourage use of community resources, such as the Cystic Fibrosis Foundation. The use of community resources may help support the family to find ways to prevent infection and increase the possibility of a positive adjustment to the condition.

The nurse must help the parents understand that caring for a child with CF can be challenging. There are sufficient resources and help lines that can assist parents, and the nurse uses these resources to provide adequate health education to parents and older children.

UPPER AIRWAY DISORDERS

Rhinosinusitis

Sinuses are hollow air spaces in the human body. In relation to the respiratory system, each sinus cavity has an opening into the nose for free exchange of air and mucus and is joined with the nasal passages by a continuous mucous membrane lining. The maxillary (behind the cheek) and ethmoid (between the eyes) sinuses are small but present at birth. The sphenoid sinuses, located behind the ethmoid sinuses, begin to develop in the first 2 years of life but are not fully visible on radiograph until about 6 years of age; they reach their permanent size by about age 12. The frontal sinuses are located between the lamina of the frontal bone and begin to develop around 7 years of age. The child's sinus cavities are not fully developed until 20 years of age, which makes the child vulnerable to sinus infection (Burns & Dunn, 2020).

Normally, mucus collects in the sinuses and drains into the nasal passages. When children have a cold or an allergy attack, the sinuses become inflamed and drainage is difficult. In addition, air is trapped within the already blocked sinus along with pus or other secretions. This inflammation and accumulation of secretions can lead to congestion and infection. There is usually accompanying facial pain, headache, and fever. Approximately 5% to 10% of upper respiratory tract infections become complicated with the development of acute sinusitis.

Signs and Symptoms

The nurse observes for the following signs and symptoms that indicate rhinosinusitis:

- A cold lasting more than 10 to 14 days, sometimes with low-grade fever
- Cough that is worse at night because of sinus drainage
- Fever
- Facial pain (may or may not be present)
- Eyelid edema (when the ethmoid sinuses are involved)
- Thick yellow-green nasal discharge
- Postnasal drip leading to sore throat, cough, bad breath, nausea, and vomiting
- Headaches (usually not before age 6)
- Maxillary or dental pain
- Decreased ability to smell (**hyposmia**)
- Ear pressure or fullness
- Irritability and fatigue
- Poor appetite

Diagnosis

Rhinosinusitis is difficult to diagnose in children because respiratory infections are more frequent during childhood. When the child comes to the health-care facility, diagnosis of acute rhinosinusitis is determined by a physical examination and the presence of purulent nasal discharge, nasal obstruction, and facial pain, pressure, or fullness with symptoms from 10 to 30 days (Burns & Dunn, 2020).

Prevention

Prevention of rhinosinusitis includes instructing the parents on allergy management, measures to relieve nasal airway obstructions, and attention to persistent nasal discharge.

Collaborative Care

NURSING CARE

The nurse's primary responsibilities in caring for the child with rhinosinusitis include assessment, medication administration, providing comfort measures, and providing instructions to the parents.

MEDICAL CARE

Medical management for uncomplicated bacterial rhinosinusitis includes a prescription of antibiotics with Amoxicillin (Amoxil) generally considered the first line of treatment. Saline irrigation via a nasal spray or irrigator may thin secretions with acute or chronic rhinosinusitis. Acetaminophen (Children's Tylenol) and ibuprofen (Children's Advil) may be used for pain relief. A cool-mist humidifier and oral fluids can relieve dry mucous membranes associated with mouth breathing.

Education/Discharge Instructions

The nurse teaches the child and parents the importance supportive care including the use of saline nasal sprays, adequate oral fluids, and cool-mist humidifiers to help relieve sinus discomfort. Parents also need to be instructed on the importance of completing the full course of antibiotic therapy to treat the cause of the bacterial infection.

Pharyngitis

Pharyngitis is an inflammation of the mucosa of the pharynx that frequently results in sore throat. It occurs most commonly in winter and is spread by close contact. The incidence is high among children and declines in late adolescence and adulthood. Most sore throats are viral in nature, most commonly caused by adenovirus. About a quarter of cases of pharyngitis are caused by group A beta-hemolytic streptococci (GABHS).

Pharyngitis can either be a short illness with no symptoms or result in severe, life-threatening illness. In cases of the latter, the causative agent is group A beta-hemolytic streptococci, which may lead to acute rheumatic fever, scarlet fever, or acute glomerulonephritis. Colonization of the pharynx by GABHS may produce either asymptomatic or acute infection. The M protein is the major virulence factor of GABHS and facilitates resistance to phagocytosis by polymorphonuclear neutrophils. Type-specific immunity develops during infection and provides protective immunity to subsequent infection with that particular M serotype.

Signs and Symptoms

- Often an abrupt onset
- Fever
- Sore throat
- Difficulty swallowing
- Headache
- Abdominal pain
- Inflamed, red, and enlarged pharynx and tonsils, often covered with exudates
- Anterior cervical lymphadenopathy
- The presence of petechiae on the palate; a fine, red, sandpaper-like rash on the trunk or abdomen; and a strawberry tongue are common findings with a group A streptococcus infection

Viral pharyngitis is usually self-limiting, with symptoms subsiding in 3 to 5 days unless superimposed by sinusitis or parapharyngeal or peritonsillar abscess.

Diagnosis

Throat culture remains a good way to diagnose streptococcal pharyngitis (Fig. 15-5). A false-positive culture can occur if other organisms are misidentified as GABHS, and children who are streptococcal carriers may have positive cultures. False-negative cultures are attributed to a variety of causes, including an inadequate throat swab specimen and a patient's covert use of antibiotics (Smith, 2020). Diagnostic test kits with rapid identification of GABHS are available for use at the office or clinic settings. These rapid tests have high specificity. Therefore, a positive result generally does not need a throat culture confirmation. The throat culture does give information about susceptibility of the organism to specific antibiotics.

Medical Care?

Viral pharyngitis is generally treated with supportive care as needed, which includes pain and fever relief with acetaminophen or ibuprofen. Most untreated cases of streptococcal pharyngitis resolve in a few days. The objective of antibiotic therapy is to hasten clinical recovery and prevent acute rheumatic fever. Antibiotics may be started immediately without culture. Oral penicillin is the prescribed treatment of choice. Oral penicillin is inexpensive and is given two or three times a day for 10 days. Oral amoxicillin (Amoxil) is suitable for children because it is available as chewy tablets or as a suspension. Oral erythromycin (Erythrocin) is indicated in children allergic to penicillin.

FIGURE 15-5 Use a long, sterile cotton swab to swab a culture from the back of the child's throat.

Education/Discharge Instructions

For children who are cared for at home, it is important that the nurse instruct the parents to give the full dose of the antibiotic prescribed even after the child shows signs of improvement. This is a very important aspect in the management of pharyngitis to prevent valvular damage of the heart. Instruct parents on methods used to provide pain and fever relief, such as administering acetaminophen (Children's Tylenol) or ibuprofen (Children's Advil) and use of a cool-mist humidifier.

Tonsillitis

Inflammation of the tonsils often occurs with pharyngitis, which may lead to the diagnosis of tonsillitis or tonsillopharyngitis. Tonsillitis is an inflammation of the tonsils, which are masses of lymphoid tissue located within the pharynx. Tonsils protect the respiratory and alimentary tracts from infection by inducing secretory immunity and regulating the production of secretory immunoglobulin. Tonsils normally enlarge progressively between 2 and 10 years of age and reduce progressively during preadolescence, so tonsils of children larger than those of adults. Nearly all children in the United States experience at least one episode of tonsillitis. Viruses and group A beta-hemolytic streptococcus are the most common cause of infection in tonsillitis.

Surgical Care

Tonsillectomy (surgical removal of the tonsils) is used for recurrent or chronic tonsillitis. The American Academy of Otolaryngology and Head and Neck Surgery suggests the occurrence of three or more treated infections per year as sufficient to necessitate a surgical intervention. Surgery is performed 6 weeks after an acute infection has been resolved.

After the surgery, children are kept on their side to facilitate drainage of secretions. Providing comfort and reducing activities that may aggravate bleeding are the priorities. Coughing, clearing the throat, and blowing the nose are to be avoided. Secretions and vomitus are checked for fresh blood. Because the throat is sore after surgery, the nurse can apply ice packs and an ice collar to provide relief. Food and fluids are offered when the child is alert, initially cool water, crushed ice, and flavored ice pops. However, red- or brown-colored fluids are not given so the nurse is able to distinguish the drainage, which might be fresh or old blood. As the child begins to tolerate food, items such as gelatin, cooked fruit, sherbet, soup, and mashed potatoes are offered. Foods to avoid include milk, ice cream, and pudding because they coat the mouth and throat and cause the child to clear the throat, which may cause bleeding.

Education/Discharge Instructions

The nurse should teach the parents to:

- Keep the child away from highly seasoned food and "sharp" foods (e.g., nacho chips) for a period of 2 weeks. The scab is most likely to be dislodged at 8 to 12 days.
- Have the child avoid gargling and vigorous tooth brushing.

- Instruct the child that he or she should not cough or clear the throat.
- Limit the child's activities that may result in bleeding.

FOCUS ON SAFETY

Signs of Bleeding After Tonsillectomy

When the nurse is caring for a post-tonsillectomy child, if the child is continuously swallowing, this indicates bleeding. Additional signs include restlessness, increased pulse rate, and pallor (late symptom). This is considered a medical emergency and the nurse should direct the patient to the ED for management.

Croup

Croup is a generic term encompassing a heterogeneous group of illnesses affecting the larynx, trachea, and bronchi. The lateral walls of the trachea below the level of the vocal cords are marked by swelling and erythema. Croup is described according to the main anatomical area affected. Epiglottitis, supraglottitis, laryngitis, laryngotracheobronchitis, and bacterial tracheitis encompass croup syndrome. Croup commonly affects children between 3 months and 5 years of age, most often around age 2. The incidence is higher in boys, and it is most frequent during the winter months. The incidence of epiglottitis has dramatically decreased since the introduction of the Hib vaccine in the late 1980s.

Viral agents, particularly the parainfluenza viruses (types 1, 2, and 3), and RSV are the most common cause of croup and account for the majority of cases. *Streptococcus pyogenes, S pneumoniae,* and *Staphylococcus aureus* are the common causes of epiglottitis while *Haemophilus influenzae, S aureus,* and *Corynebacterium diphtheriae* are involved in bacterial tracheitis.

Signs and Symptoms

The symptoms of croup can be explained in terms of the child's anatomical structure. The subglottic region of the larynx is held within the rigid ring of the cricoid cartilage. Symptoms are related to the extent of upper airway involvement and the infectious agent responsible for the croup. Croup can lead to obstruction because children have a narrow larynx, such that a decrease in airway diameter causes a decrease in airflow, leading to the symptoms of croup.

Acute laryngotracheitis is characterized by these signs and symptoms:

- Usually viral (parainfluenza, adenovirus, RSV)
- Peak age is 3 to 36 months
- Gradual, acute onset during the night
- URI symptom
- Seal-bark cough
- Mild to moderate dyspnea
- Symptoms worse at night
- Low-grade fever
- Respiratory rate less than 50

Spasmodic croup typically has these manifestations:

- Usually viral
- Peak age is 3 to 36 months
- Generally no preceding illness, though may have coryza
- Sudden onset, often at night
- Fever variable
- Barky cough
- Hoarseness

Epiglottitis displays the following characteristics:

- Peak age is 1 to 5 years
- Rapid onset
- Sore throat
- Dysphagia
- Anxiety related to inspiratory distress
- Drooling
- Muffled speech
- Toxic appearance
- Tripod positioning
- Marked distress
- High fever ranging from 101.8°F to 104°F (38.8°C to 40°C)

Croup is characterized by these findings:

- Usually caused by *Staphylococcus aureus* (Smith, 2020)
- Peak age is 3 to 36 months
- Acute onset
- Hoarseness
- Barky cough
- Inspiratory stridor
- Toxic appearance
- Purulent sputum
- Marked distress
- High fever 102.2°F (39°C)

Bacterial tracheitis symptoms include the following:

- Considered a bacterial complication of a viral disease
- Can lead to a life-threatening airway obstruction severe enough to cause respiratory arrest
- Preceded by upper respiratory tract infection
- "Croupy" cough
- Stridor unaffected by position
- Toxic appearing
- High fever
- Stridor
- Hoarseness
- Dyspnea
- Retractions and nasal flaring
- Thick purulent tracheal secretions

Laryngitis typically has these characteristics:

- More common in older children
- Usually caused by a virus
- Hoarseness
- May have upper respiratory symptoms including coryza, sore throat, and nasal congestion
- Malaise
- Low-grade fever
- Headache
- Myalgia

Medical Management

Corticosteroids are the mainstay of therapy for croup, regardless of clinical severity. A single dose of dexamethasone (0.15 to 0.60 mg per kg usually given orally) is recommended in all patients with croup, including those with mild

disease. Nebulized epinephrine is an accepted treatment in patients with moderate to severe croup (AAFP, 2020). Dexamethasone and inhaled budesonide relieve croup symptoms as early as 3 hours after treatment. Based on historical data, nebulized adrenaline in children with severe croup substantially reduces the number requiring an artificial airway. Adrenaline reduces respiratory distress within 10 minutes of administration and lasts longer than 1 hour.

Acute Epiglottitis

Acute epiglottitis or supraglottitis is a medical emergency presenting as a sudden, potentially lethal condition characterized by high fever, sore throat, dyspnea, and rapidly progressing respiratory obstruction. Acute epiglottitis is a serious obstructive inflammatory condition that requires immediate attention.

NURSING INSIGHT

Indications of Epiglottis

A common scenario is that the child goes to bed asymptomatic and awakens with complaints of sore throat and pain or swelling accompanied by a febrile state. The classic sign of acute epiglottitis is when the child sits upright in a **tripod position** with the chin thrust out (sniff position). The child's mouth is open with drooling, a protruding tongue, and dysphagia. The child is irritable and restless with a thick and muffled voice and frog-like croaking sound on inspiration. Suprasternal and substernal retractions may be visible. The nurse notes that the child breathes slowly, the throat is red and inflamed, and displays a distinctive large, cherry-red, edematous epiglottis.

FOCUS ON SAFETY

Hospitalization

Symptoms that warrant hospitalization are progressive stridor, severe stridor at rest, respiratory distress, hypoxia, cyanosis, inability to maintain an adequate SpO2 oxygenation on room air and depressed mental status (confusion, altered levels of consciousness, etc.).

Diagnosis

Diagnosis of croup is based on the signs and symptoms along with history, and treatment takes priority over testing because of the severity of respiratory distress. Soft tissue imaging of the neck and chest demonstrates the classic presentation of subglottic narrowing or the **"steeple sign."** When epiglottitis is suspected, blood cultures are ordered to identify the causative organism. A radiograph of the lateral neck may present with the "thumb sign," which describes the x-ray appearance of the epiglottis. The diagnosis of a bacterial cause for croup, such as in the case of bacterial tracheitis and LTB, can be confirmed by an elevated white blood cell count, which includes leukocytosis with a left shift. Bacterial tracheitis can be differentiated from epiglottitis by a slower onset, the absence of the thumb sign, and classic symptoms presented in epiglottitis.

Prevention

Routine immunization with Hib provides primary prevention of epiglottitis. Good hand washing, proper tissue disposal, and covering the nose and mouth when coughing are effective methods of preventing spread of infection.

FOCUS ON SAFETY

Epiglottitis

If epiglottitis is suspected, **DO NOT** attempt to visualize the throat with a tongue blade because this may cause a laryngospasm leading to an immediate airway occlusion. If the health-care provider plans to do a direct laryngoscopy, the nurse prepares for tracheal intubation because of the potential for an airway occlusion. The insertion of an artificial airway may rapidly improve the child's respiratory status.

Collaborative Care

NURSING CARE

In mild croup, a child may present with only a croupy cough and may just require parental guidance and reassurance, given alertness, baseline minimal respiratory distress, proper oxygenation, and stable fluid status.

The nursing care measures for croup depend on the various causative organisms. The most important goal in the treatment of children with croup is maintaining the airway and providing adequate respiratory exchange. The nurse stays at the child's side to reduce child and parent anxiety, observes for worsening symptoms, and helps the child maintain a position that supports maximum airway and respiratory exchange. Key areas of nursing responsibility include maintaining the airway, providing rest and humidification, monitoring fluid balance, and administering medications as prescribed. Changes in condition are based on observations and assessment of the child's response to therapy, including careful observation of the child's response to their surroundings (changes in level of consciousness).

Urgent care or emergency department treatment of croup depends on the patient's degree of respiratory distress:

- Corticosteroids. Corticosteroids are beneficial due to their anti-inflammatory action; their use decreases both laryngeal mucosal edema and the need for salvage nebulized epinephrine; corticosteroids may be warranted even in those children who present with mild symptoms.
- Epinephrine. Patients who receive nebulized racemic epinephrine in the emergency department should be observed for at least 3 hours after last treatment because of concerns for a return of bronchospasm, worsening respiratory distress, and/or persistent tachycardia; patients can be discharged home only if they demonstrate clinical stability with good air entry, baseline consciousness, no stridor at rest, and have received a dose of corticosteroids.

- Heliox. Heliox is a gas that contains a mixture of helium and oxygen (with not less than 20% oxygen); delivery to the patient is via nasal cannula, face mask, or hood; it has low viscosity and low specific gravity, which allows for greater laminar airflow through the respiratory tract; helium facilitates the movement of oxygen through the airways and decreases the mechanical work of respiratory muscles; this clinical response reduces respiratory distress.

As previously mentioned, current treatment approaches for patients with croup are corticosteroids and nebulized epinephrine; steroids have proven beneficial in severe, moderate, and even mild croup.

- Corticosteroids. Steroids are thought to decrease airway edema via their anti-inflammatory effect; corticosteroids have been shown to reduce hospitalization rates by 86%, and in mild disease, they have been proven to reduce the number of children returning to the ED for further treatment.
- Epinephrine. Epinephrine stimulates alpha receptors and beta2 receptors; it constricts the precapillary arterioles, thus decreasing airway edema; because of the potential adverse effects of tachycardia and hypertension, it is reserved for children with moderate to severe disease.

MEDICAL CARE

Mild cases of croup are commonly treated with cool mist. A high-humidity, cool air vaporizer may be used at home in the child's room. In the hospital setting, oxygen hoods for infants and oxygen tents for toddlers are used. Cool mist is thought to moisten airway secretions to facilitate clearance, soothe inflamed mucosa, and provide comfort and reassurance to the child thereby lessening anxiety. Nebulized racemic epinephrine (Micronefrin or Vaponefrin) (0.25 to 0.5 mL in 3 mL of a normal saline solution) or *l*-epinephrine (5 mL of 1:1,000 solution) are equally effective to cause mucosal vasoconstriction and consequently decrease subglottic edema, thus relieving the symptoms. This treatment is indicated for those with moderate to severe stridor at rest or when stridor does not respond to cool mist. Observe the child after nebulization to assess the airway and side effects of the delivered medication.

Corticosteroids are also given to children to decrease the edema in the laryngeal mucosa through their anti-inflammatory action. IM dexamethasone (Decadron) and nebulized budesonide (Pulmicort) are widely used.

Antibiotic therapy is indicated for epiglottitis and bacterial tracheitis. Combinations of ampicillin and sulbactam (Unasyn) are the drugs most often prescribed. Antibiotics are not used in the management of viral croup.

Education/Discharge Instructions

Parents are instructed on the use of cool-mist humidification, as well as the use of a steamy bathroom to help modify respiratory symptoms. If the child has been hospitalized and discharged on medications, the parents also need information about the importance of compliance and the proper administration and dosage of medications. Parents are also instructed on symptoms of potential side effects of the medications and the symptoms of a worsening condition (e.g., specifically increased signs of respiratory distress, restlessness, and confusion).

LOWER AIRWAY DISORDERS

Bronchitis

Bronchitis is a nonspecific bronchial condition in which the bronchial tubes are inflamed. It is unusual for children to be diagnosed with bronchitis alone; other associated upper and/or lower respiratory tract conditions are likely to be involved because of the proximity of the respiratory tract structures. Tracheobronchitis is a more common term used when the trachea is prominently involved.

Bronchitis may be acute or chronic. Acute bronchitis is commonly preceded by a viral upper respiratory tract infection and may last for 1 to 3 weeks. The incidence of acute bronchitis is highest during the winter months. Children are usually affected in their first 4 years of life. Chronic bronchitis lasts for months or years and is more common among adults, particularly smokers. The incidence of chronic bronchitis in children is also more often associated with cigarette smoking or the presence of secondhand smoke, as well as with the presence of another chronic condition such as allergies, asthma, or CF.

Viruses are usually the causative organism. The tracheobronchial epithelium is invaded by the infectious agent, and this leads to activation of inflammatory cells and release of cytokines, giving way to the occurrence of symptoms. If the tracheobronchial epithelium becomes significantly damaged or hypersensitized, then a protracted cough may last for 1 to 3 weeks.

Signs and Symptoms

- Dry, hacking cough that becomes more productive and purulent over time and worsens at night
- Rhinorrhea occurring 3 to 4 days after onset of a cough
- Signs of nasopharyngeal infection and conjunctivitis
- Coarse breath sounds, rhonchi, and coarse, changing rales
- Low-grade or no fever
- Low substernal discomfort or burning in the chest
- A productive cough lasting more than 3 months with chronic bronchitis

Diagnosis

Because a virus is usually the causative organism, bronchitis is diagnosed based on the child's symptoms. In children older than 6, *M pneumoniae* is a common cause, and bronchitis can be determined by the identification of this bacterium.

Prevention

Good hand washing, covering the nose and mouth when coughing, and care in avoiding touching eyes and nose can help prevent the spread of the organisms that cause bronchitis. Instruct parents on the avoidance of secondhand smoke, dust exposure, known allergens, air pollution, crowded places during flu seasons, and contact with persons known to have bronchitis.

Collaborative Care

NURSING CARE

Nursing care is generally directed toward providing supportive care and adequate air exchange. To provide oxygenation, the nurse must ensure that the airway is open and free

of obstruction. The airway can be opened by administering prescribed bronchodilators. The nurse encourages the child to clear the airway from secretions by coughing. Use of a cool-mist humidifier at the bedside may help liquefy secretions, which promotes expectoration when coughing. Secretions are disposed of in sealed plastic bags.

MEDICAL CARE

For acute bronchitis, care is primarily supportive. Symptom relief may include use of antipyretics, analgesics, and humidity. Cough suppressants are administered with caution because they interfere with clearance of secretions. The condition is self-limiting, and antibiotics, though often prescribed, do not hasten improvement in uncomplicated cases. The treatment for chronic bronchitis depends on the cause or underlying condition.

Education/Discharge Instructions

Home care may include instructing the parents on using a cool-mist humidifier, providing sufficient fluids and nutrition, and encouraging the child to expectorate secretions. Parents are instructed to avoid exposing the child to secondhand smoke, environmental pollutants, and known allergens.

Bronchiolitis and Respiratory Syncytial Virus (RSV)

Bronchiolitis is an inflammation of the bronchioles and small bronchi. Bronchiolitis causes lower respiratory tract obstruction because of inflammation and edema, which may lead to bronchospasms. Bronchiolitis is usually caused by viral pathogens, such as RSV, adenovirus, and parainfluenza virus (types 1, 2, and 3), among others. Respiratory syncytial (sin-SISH-uhl) virus, or RSV, is a common respiratory virus that usually causes mild, cold-like symptoms. Most people recover in a week or two, but RSV can be serious, especially for infants. In fact, RSV is the most common cause of bronchiolitis (inflammation of the small airways in the lung) and pneumonia (infection of the lungs) in children younger than 1 year of age in the United States (CDC, 2020). By the age of 2, nearly every child has been exposed to the virus.

RSV peaks in the winter, generally beginning as early as September or October and continuing through April or May. Bronchiolitis is common among children age 2 years and younger. Nearly 80% of the cases of bronchiolitis occur in children younger than 1 year of age. Bronchiolitis is highly contagious and spreads by direct contact with respiratory secretions or from particles on contaminated objects. Bronchiolitis is easily spread from hand to eye, nose, and mucous membranes.

The peak period for a child to acquire RSV is December through March. RSV most often begins as an infection in the nasal epithelial cells. The RSV virus then replicates in the host cell. The host cell is destroyed, and virus particles are released to propagate the infection. The infection results in the destruction of the epithelial cells of the respiratory tract. Exposure to RSV triggers a humoral immune response. Primary RSV infection results in only a weak antibody response with IgM, IgG, and IgA produced. This response is not enough to destroy the virus completely or to prevent upper respiratory tract replication of the virus. Consequently, an upper respiratory tract illness develops. High levels of neutralizing antibodies are required to prevent the progression of infection from the upper respiratory tract to the lower respiratory tract.

Signs and Symptoms

- Upper respiratory infection (URI) symptoms of cough, coryza, and rhinorrhea lasting 3 to 7 days
- Respiratory distress marked by noisy, raspy breathing and cyanosis
- Audible wheezing
- Retractions
- Rales and prolonged expiratory phase of respirations
- Tachypnea
- Low to moderate fever up to 102°F (38.9°C)
- Decreased appetite and poor feeding
- Pharyngitis
- Depending on the duration of symptoms and oral intake, dehydration may be manifested by poor tearing, dry mucous membranes, and poor skin turgor
- Thick mucus, exudate, and mucosal edema obstruct the smaller airways (bronchioles) leading to a reduction in expiration, air trapping, and hyperinflation of the alveoli
- The obstruction interferes with gas exchange, possibly leading to hypoxemia (decreased oxygen) and hypercapnia (increased carbon dioxide in the blood), which in turn leads to respiratory acidosis
- May be accompanied by otitis media and conjunctivitis
- May result in hospitalization

Diagnosis

Positive identification of RSV is accomplished from nasal secretions or nasopharyngeal washings. These are tested for the virus or for the antibodies the virus makes.

Prevention

Proper hand washing, reducing exposures to and transmission of RSV, and avoiding secondhand smoke are the best means of prevention. The monoclonal antibody palivizumab (Synagis) is given IM to high-risk infants and shown to be effective in reducing the complications of RSV, hospitalization, and associated morbidities as prophylaxis for high-risk infants.

Collaborative Care

NURSING CARE

RSV is treated symptomatically through maintenance of hydration, fever control, oxygenation, and keeping the mucous membranes clear of mucus. Children may be managed at home. Hospitalization is recommended for children who have some other underlying illness or are in a debilitated state. In the hospital, nursing care includes head elevation of 30 to 40 degrees, oxygen saturation monitoring, and cool-mist therapy combined with oxygen administered by hood or tent in concentrations sufficient to alleviate dyspnea and hypoxia. The nurse administers IV fluids until the child shows signs of improvements.

Strict isolation is required for patients infected with RSV virus because it is easily spread from hand to eyes or nose and other mucous membranes. The nurse emphasizes hand washing and that contact precautions such as the use of gown, gloves, and masks are required (Fig. 15-6). Parents need to know that the first 24 to 72 hours is the critical time and in most cases children recover completely.

FIGURE 15-6 When a child has respiratory syncytial virus, contact precautions, such as the use of gowns, gloves, and masks, are required.

MEDICAL CARE

The clinical goal is to return the child to a normal respiratory status. Medical therapy is aimed at relief of respiratory distress, improvement in oxygenation, and alleviation of airway obstruction.

Education/Discharge Instructions

Educate parents on the importance of watching for signs of worsening conditions, such as signs of respiratory distress and dehydration, and on when to seek care. Instruct parents on the use of cool-mist humidification, providing fluids, and fever control. Parents can be instructed to manage rhinitis with saline drops and nasal suctioning.

Pneumonia

Pneumonia is a lower respiratory tract infection of the pulmonary parenchyma. It is more common in infancy and early childhood and may occur as a primary infection or secondary to another illness or infection. Pneumonias are classified as lobar, bronchopneumonia, and interstitial. Lobar pneumonia involves lobes of the lungs. Viral pneumonia, a more common form, involves RSV infection in infants and parainfluenza and adenoviruses in older children, whereas *Streptococcus pneumoniae* is the common pathogen causing bacterial pneumonia. Viral pneumonia accounts for 45% of pneumonia cases (Redjal, 2020). A viral infection can have a secondary bacterial infection 6 to 8 days after initial onset because of viral insult of protective mechanisms.

Aspiration pneumonia may occur as a result of aspiration of foreign material into the lower respiratory tract.

Collaborative Care

NURSING CARE?

Nursing care is primarily directed toward providing supportive care and educating the family about the illness and management. Supportive care includes ensuring adequate hydration, which will help in thinning secretions. Oxygen administration via nasal cannula with cool mist, CPT, and postural drainage are initiated for patients requiring hospitalization. Supplemental oxygen may be necessary with children experiencing significant respiratory distress and who would be easily fatigued by activities. IV fluids help prevent dehydration. Elevating the head of the bed will promote improved air exchange of the lungs.

Labs

Sputum Culture and Sensitivity

To establish the causative organism and the most effective and appropriate antibiotic, culture and sensitivity tests of the sputum are performed. Coughed-out sputum is difficult to obtain from children, especially those who are very young. A specimen may be obtained via a direct throat swab immediately after coughing. In some cases, a sterile catheter may be inserted directly into the trachea through the ET tube or during direct laryngoscopy. During sleep, children usually swallow their sputum; therefore, an early morning fasting specimen obtained via gastric aspiration may also be obtained. The gastric content can be collected before breakfast by inserting the naso-oral tube into the stomach.

The nurse must place the specimen in the appropriate container and properly label it with the patient's name, the nature of the specimen, date and time collected, and the examination desired. Ideally, the specimen must be sent immediately to the laboratory. If this is not feasible, the specimen is kept in a refrigerator until it is taken to the laboratory. Results of the test may be reported in 2 or more days.

Nursing care measures such as changing the child's clothes and linen take place frequently to prevent chills. Positioning the child on the affected side naturally splints the chest and reduces pleural rubbing that causes discomfort. Assess the child's sputum for color, amount, and consistency. The sputum assessment must be recorded in the child's record.

To detect any change in condition, assess vital signs and breath sounds. Also assist the child and the parents in alleviating anxieties through continuous emotional support and reassurance.

MEDICAL CARE

Most cases of pneumonia can be treated at home with rest and fluids and symptomatic management with analgesics and antipyretics. Antibiotics are given for bacterial pneumonia and not for viral pneumonia. If antibiotics are given, the drugs may range from amoxicillin (Amoxil) to the third generation cephalosporins, depending on the severity of the condition. Bronchodilators also might be used. Analgesics may reduce the pain associated with coughing.

Education/Discharge Instructions

Treatment of a child with pneumonia is supportive depending on the severity of the symptoms. Education includes instructing the parents on the importance of adhering to the prescribed antibiotic regimen. Parents of infants may need to be instructed to continue frequent, small feedings because the child may tire easily. Inform the parents that complete recovery from pneumonia may occur in about 2 weeks. Even if the child is feeling better after treatment, gradual return to normal activities like school and play are encouraged.

INFECTIOUS CONDITIONS

Pertussis

The causative organism of pertussis is *Bordetella pertussis,* a gram-negative coccobacillus. The disease is spread via droplet infection and direct contact with discharges from respiratory mucous membranes of an infected child. Pertussis is highly contagious; approximately 80% to 90% of susceptible individuals exposed to the infection develop the disease.

In this condition, *B pertussis* attaches to and multiplies on the respiratory epithelium, starting in the nasopharynx and ending primarily in the bronchi and bronchioles (John & Brady, 2012a). A tracheal cytotoxin is produced that is responsible for the local epithelial damage that produces the respiratory symptom.

Signs and Symptoms

Pertussis is divided into three stages: catarrhal, paroxysmal, and convalescent stages. The classic cough of pertussis lasts from 6 to 10 weeks. Each of the stages lasts for 2 to 4 weeks. The incubation period ranges from 6 to 21 days.

CATARRHAL STAGE

- Lasts 1 to 2 weeks
- URI similar to common cold
- Mild cough, coryza, and sneezing
- Low-grade fever less than 101°F (38.3°C)

PAROXYSMAL STAGE

- Lasts 2 to 4 weeks
- Fever absent or minimal
- Persistent staccato, paroxysmal cough ending with an inspiratory whoop
- Cyanosis, sweating, prostration, and exhaustion from coughing
- Coughing may be accompanied by a red face and protruding tongue
- Conjunctival hemorrhage and facial petechiae may occur related to the force of the cough
- Saliva, mucus, and tears may flow from nose, eyes, and mouth during cough
- Vomiting may accompany coughing

CONVALESCENT STAGE

- Lasts 3 weeks to 6 months
- Symptoms diminish
- Coughing becomes less severe and paroxysms and whoops slowly disappear
- Cough may persist for months and is aggravated by physical stress and respiratory irritants

Diagnosis

It is not easy to diagnose pertussis because the initial symptoms are similar to those of other upper respiratory tract infections. The diagnosis of pertussis is based on a history of severe coughing, with or without a whoop, reddening of the face during coughing, and incomplete or absent pertussis vaccination.

Blood testing will show profound lymphocytosis, usually more than 70% of the total WBC count, which often increases to 20,000 to 40,000 or even 100,000 cells/mm^2. Chest radiography may show focal atelectasis and/or peribronchial cuffing.

The criterion standard for diagnosis of pertussis is isolation of *B pertussis* in a culture from a swab taken from nasopharyngeal secretions. Polymerase chain reaction (PCR) testing to detect DNA is also common. The CDC recommends both culture and PRC tests if a child has a cough lasting longer than 3 weeks. Many health-care professionals now consider serological testing with enzyme linked immunosorbent assay (ELISA) to be the criterion testing standard.

Prevention

Primary preventive care occurs through vaccination against the disease with DTaP. The vaccine is a combination of diphtheria, pertussis, and tetanus toxoids. DTaP is recommended at 2, 4, 6, and between 15 and 18 months with a booster at 4 to 6 years. A booster is also recommended for adolescents between 11 and 12 years of age. The vaccine has an efficacy of 70% to 90% and may not prevent the illness entirely, but it has been shown to lessen disease severity and duration (CDC, 2020).

Collaborative Care

NURSING CARE

The goals of nursing care include limiting the number of paroxysms; observing the severity of cough; and maximizing nutrition, hydration, rest, and recovery. During hospitalization, the nurse can implement droplet precaution. This isolation technique that decreases transmission of organisms when an infected child coughs, sneezes, or spits (Venes, 2017). Droplet precautions are recommended for 5 days after the commencement of therapy or 3 weeks after the onset of paroxysmal cough if no antimicrobial therapy has been given. During hospitalization, the nurse must vigilantly monitor the child's vital signs and oxygen saturation. Nursing care also centers on the child's hydration and nutritional status. If the child is unable to drink, an IV infusion is given. The nurse accurately records coughing, feeding, vomiting, and weight changes.

MEDICAL CARE

Antibiotic therapy is given to eradicate the infection, reduce morbidity, and prevent complications. Erythromycin (Erythrocin) is the drug of choice for pertussis. It is given at 40 to 50 mg/kg per day (not to exceed 2 g) four times in a day for 14 days. Children allergic to erythromycin (Erythrocin) are given trimethoprim sulfamethoxazole (Bactrim) (Smith, 2020). Corticosteroids may be used to reduce the severity of the illness although they could mask a superinfection.

Education/Discharge Instructions

The nurse also instructs the parents that no special diet is required for the child because the child is fed according to what is tolerated. The same is true for the child's activities.

For as long as the child can tolerate, he or she can participate in regular activities and play. The prognosis for recovery is good for children who are well-managed. It is important for the nurse to emphasize the importance of follow-up checks.

Pulmonary Tuberculosis

Tuberculosis (TB) is a chronic bacterial infection, usually of the lungs, that is spread through the air. *Mycobacterium tuberculosis* is its most common causative agent (Rollet-Cohen, Roux, Le Bourgeois, et al, 2019). There was a declining rate of TB until the mid-1980s, when outbreaks drew new attention to this disease. This outbreak was brought about by the increase in immunosuppressed individuals, particularly those with HIV, as well as an increase in drug-resistant strains.

Aside from *M tuberculosis, Mycobacterium bovis* may also affect children because the microorganism may be present in unpasteurized milk or milk products. Latent TB infection occurs after the inhalation of infective droplet nuclei of *M tuberculosis.* Conditions such as lowered body resistance, HIV infection, malnutrition, untreated upper respiratory tract infection, and other debilitating conditions increase the chance acquiring an active infection.

Transmission of TB is person-to-person through airborne droplet nuclei. It rarely occurs by direct contact with infected discharge or a contaminated fomite (any substance that adheres to and transmits infectious material) (Redjal, 2020). Young children with TB rarely infect other children or adults because the tubercle bacilli are sparse in the endobronchial secretions of children and cough is often absent or lack the force necessary to suspend the infectious particles.

When the organism enters the lungs, a proliferation of epithelial cells surrounds and encapsulates the multiplying bacilli to ward it off. This process forms the typical tubercle. The extension of the primary lesion causes progressive tissue destruction as it spreads within the lungs. The tubercle bacilli are carried to most tissues of the body through the blood and lymphatic vessels.

Other forms of TB are abdominal or GI tract TB, which occurs from swallowing infected material. It may involve associated TB peritonitis. Urogenital TB involves the kidneys. Once a person becomes infected with the organism, progression may occur in three different directions. The infection can heal, which occurs 90% of the time; the person may experience a primary infection that leads to an active case of TB; or a primary infection heals and the organism becomes dormant, which reactivates months to years later, generally in relation to something that causes stress or major life changes. This occurs in approximately 10% of individuals. Once infected with the organism, the person will have a positive tuberculin skin test regardless of whether an active case occurred.

Signs and Symptoms

Many children with TB may be asymptomatic and do not develop symptoms early in the infection. When symptomatic, children present with the same clinical manifestations as adult patients, which include:

- Low-grade fever
- Mild cough
- Night sweats
- Flu-like symptoms that resolve within a week may be observed
- Anorexia and weight loss may follow as the disease progresses

Diagnosis

The diagnosis of TB in children is challenging because they exhibit a variety of symptoms. Exact diagnosis of TB is based on the child's physical signs and symptoms, the history of exposure to TB, x-ray films that may show evidence of *M tuberculosis* infection, and laboratory cultures that may confirm the diagnosis. Early morning gastric contents from the stomach may be helpful in diagnosing TB. However, it takes about 4 weeks for the culture test to confirm the diagnosis because the bacillus grows slowly on a culture medium. Skin testing for TB is based on delayed hypersensitivity.

The test does not become positive until 3 weeks to 3 months after the person has inhaled the organism. A positive TB skin test is an indication for a radiographic evaluation, which may suggest, but not confirm, the diagnosis. The positive skin test does not indicate an active case, only that the person has become infected with the organism. Skin testing is also not always accurate; up to 40% of children with positive cultures have negative skin tests (Blosser et al., 2012). The accuracy may be affected by the presence of HIV, malnutrition, viral illnesses, and poor injection technique or interpretation error. The diagnosis is confirmed by a positive culture of sputum or other body fluids, such as urine, gastric lavage, or spinal fluid.

Prevention

Prevention is directed toward avoiding contact with the organism. This includes screening populations at risk to identify and treat infected persons, which helps avoid secondary transmission from close contact. Health-care settings can avoid transmission through the use of appropriate physical ventilation of air around the infected case. Health-care facilities should have adequate ventilation with air exhausted to the outside via negative-pressure ventilation (Redjal, 2020). In addition, health-care providers should have annual testing. BCG is the only available vaccine that is not routinely used in the United States. Studies demonstrate varying degrees of protection, ranging anywhere from no protective efficacy to 90% protection (Redjal, 2020). Drinking pasteurized milk helps decrease transmission of *M bovis.*

Collaborative Care

NURSING CARE

Nursing care is supportive and directed toward educating the parents to adhere to the medication regime. Supportive care also involves ensuring the patient has adequate rest, nutrition, and hydration, as well as aiding fever reduction and avoiding exposure to others. Most individuals receive care on an outpatient basis through clinics, schools, or a public health setting. However, in cases of serious infection and involvement of other organs, children may need hospitalization. Children started with drug therapy are not contagious and require only standard precautions. Children with no cough and negative sputum smears may be cared for without isolation. Children with contagious infections must be placed in isolation.

During the child's hospitalization, the nurse must work closely with the family and the child to ensure that optimal care is provided. The nurse can explain the nature of disease and how children are at high risk of getting the infection.

The nurse must emphasize good hand washing to reduce the chance of transmission from one person to another.

During hospitalization, the nurse must assist the child in collecting different specimens for the diagnosis, which includes sputum for culture. Children are unable to cough properly, so sputum may be difficult to collect from the young child.

MEDICAL CARE

Children over 2 years of age can be treated for latent TB infection with once-weekly isoniazid-rifapentine for 12 weeks. Alternative treatments for latent TB infection in children include 4 months of daily rifampin or 9 months of daily isoniazid. The regimens are equally acceptable; however, health-care providers should prescribe the more convenient shorter regimens, when possible. Patients are more likely to complete shorter treatment regimens.

TB disease is treated with a regimen of several anti-TB medicines for 6 to 9 months. It is important to note that if a child stops taking the drugs before completion, the child can become sick again. If drugs are not taken correctly, the bacteria that are still alive may become resistant to those drugs. TB that is resistant to drugs is harder and more expensive to treat, and treatment lasts much longer (up to 18 to 24 months).

Education/Discharge Instructions

The family of the child can be informed about the benefits of DOT. Nurses can discuss with the family about the methods for giving the medicines (e.g., tablets may need to be crushed well to facilitate its oral intake). The availability of liquid preparation in syrup form may be explored. The nurse can tell the family that they need to follow precautionary measures to prevent latent infection. The nurse emphasizes regular follow-up visits and regular intake of medications.

Influenza

Influenza, or flu, is a common infection of the respiratory system caused by viruses. Infants and children are most vulnerable to the influenza virus. It is estimated that children are 3 times more likely to become ill with influenza than adults are. The American Lung Association notes that in the United States influenza and its related complications result in an estimated 226,000 hospitalizations and anywhere from around 3,000 to 49,000 deaths annually, particularly among older individuals and those with chronic medical conditions. The disease rapidly spreads worldwide in seasonal epidemics. Influenza is most common during the winter months.

Labs

Tuberculin Skin Test

The TST is an exact indicator whether a child has been infected with the tubercle bacillus. The TST consists of injecting a measured amount of the intermediate strength of 5 tuberculin units of tuberculin-purified protein derivative intradermally to form a small wheal in the forearm. In 48 to 72 hours, a positive reaction is marked by an area of red induration (an area of hardened tissue). Reactions are classified based on the diameter of the induration. A reaction greater than or equal to 15 mm is considered positive in children 4 years of age and older. A reaction of 10 mm in size are considered positive in children younger than 4 years of age and with high risk factors, such as underlying kidney disease, diabetes, or known contact with a health-care worker or other person with active TB. A reaction of 5 mm of induration is considered positive in immunocompromised patients. A reaction of less than 2 mm, without blistering, is considered a negative TST. The American Academy of Pediatrics recommends that administration and interpretation of the TST be performed and read by trained health-care professionals (Fig. 15-7).

Three types of virus cause influenza. Influenza types A and B are the major influenza pathogens and cause epidemics. These viruses mutate and create different strains. Influenza type C causes mild symptoms and does not cause epidemics. Regular H1N1 and H3N2 are categorized under type A influenza and are included in the seasonal flu vaccine. Type B viruses are generally not found in humans, although they can cause illness with less severe symptoms. Type C viruses cause mild illness in humans and are not typically included in the seasonal flu vaccine. Influenza is spread through droplets when an infected person coughs, sneezes, or speaks. Indirectly, articles contaminated by nasopharyngeal secretions may spread the infection. Infected individuals shed the virus for 1 to 2 days before symptoms appear and may continue to shed the virus in increasing amounts for as long as 2 weeks. Influenza causes a lytic (cellular destruction) infection of the respiratory epithelium with loss of ciliary function, decreased mucus production, and desquamation of the epithelial layer. These changes may permit secondary bacterial invasion directly from the epithelium or through the middle ear space.

Signs and Symptoms

- Abrupt onset of fever
- Facial flushing

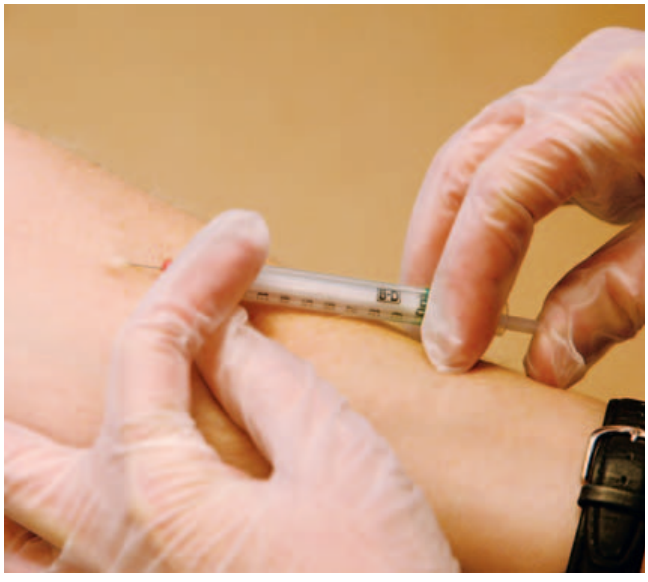

FIGURE 15-7 Nurse is performing a tuberculin skin test.

- Chills
- Headache
- Myalgia
- Malaise
- Diarrhea, nausea, and vomiting
- Cough
- Coryza
- Dry or sore throat
- Photophobia, tearing, burning, and eye pain may occur
- Complications include severe viral pneumonia, encephalitis, and secondary bacterial infections such as otitis media, sinusitis, or pneumonia
- Flu symptoms in children are similar to that of adults, except that children have higher degrees of fever of up to 105.1°F (40.6°C)

Diagnosis

The diagnosis of flu is based on the child's signs and symptoms and epidemiological considerations. In the presence of a known epidemic, a child who has symptoms of fever, malaise, and respiratory illness may easily be diagnosed. Laboratory tests may also isolate the virus from the nasopharynx if done early in the course of illness. Rapid influenza diagnostic tests are available, although they have varying degrees of sensitivity. Results may be obtained within 15 minutes, but their routine use should be considered based on whether the results would change the clinical care. Nasopharyngeal swabs or aspiration taken within 72 hours of the onset of the symptoms can isolate and confirm the virus in 2 to 6 days.

Prevention

Prevention includes frequent hand washing, covering the mouth and nose when sneezing or coughing, properly disposing of used tissues, and avoiding close contact with persons who may have become infected. Influenza vaccines are now widely used for prevention. There are two routes for the vaccines: IM and nasal spray. Vaccination is recommended annually to populations at risk because the flu virus is continuously changing. Current guidelines recommend that all children ages 6 months to 18 years be immunized with 2 doses being administered during the first year of immunization. In addition, health-care providers should receive a yearly influenza vaccine to protect themselves and prevent spread to patients and their families.

Collaborative Care

NURSING CARE

Because influenza is a self-limiting condition, nursing care is supportive. Depending on the severity of influenza, the child recovers within 1 to 2 weeks. The nurse must emphasize to the parents the importance of adequate rest and sleep. When the child has the flu, more fluids are offered. An electrolyte solution is recommended. The nurse can reiterate the importance of having an annual vaccination.

MEDICAL CARE?

In uncomplicated cases, influenza is treated symptomatically because symptoms usually recede in 48 to 72 hours. Adequate rest and fluid intake are important components of the regimen. For fever and pain, acetaminophen (Children's Tylenol) or ibuprofen (Children's Advil) is given. Antiviral drugs such as oseltamivir (Tamiflu), amantadine (Symmetrel), and rimantadine (Flumadine) are currently used to manage influenza. These medications are usually given in the first 48 hours to decrease the severity and duration of the illness. Antibiotics are given when there is evidence of a superimposed bacterial infection, like prolonged fever and deterioration of the condition.

MEDICATION: Oseltamivir (Tamiflu)

(o-sel-**tam**-i-vir)

Indications: Used for uncomplicated acute illness due to influenza infection in adults and children greater than 1 year of age that have had symptoms for greater than 2 days

Prevention of influenza in patients greater than 1 year

Unlabeled Use: Treatment or prophylaxis for infection in infants less than 1 year and of patients symptomatic for 2 days with severe illness.

Actions: Inhibits the enzyme neuraminidase, which may alter virus particle aggregation and release.
THERAPEUTIC EFFECTS: Reduced duration of flu-related symptoms.

Contraindications and Precautions:

CONTRAINDICATED IN: Hypersensitivity and children less than 1 year old.

Adverse Reactions and Side Effects:

CNS: Insomnia, vertigo, seizures, abnormal behavior, agitation, confusion, delirium, hallucinations, nightmares

RESP: Bronchitis

GI: Nausea, vomiting

Route and Dosage:

PO:
Children greater than 88 lb (40 kg): 75 mg twice daily for 5 days
Children 50.6 to 88 lb (23–40 kg): 60 mg twice daily
Children 33 to 50.6 lb (15–23 kg): 45 mg twice daily
Children less than 33 lb (15 kg) and less than 1 year: 30 mg twice daily

Nursing Implications:

1. Monitor influenza symptoms. Additional supportive treatment may be indicated to treat symptoms. Treatment should be started as soon as possible from the first sign of flu symptoms. Administer with food or milk to minimize GI irritation.
2. Drug should be used within 10 days of constitution.
3. Caution patients/parents that Tamiflu should not be shared with anyone even if they have the same symptoms.
4. Tamiflu is not a substitute for flu shots according to immunization guidelines.
5. Advise patient to consult health-care professional before taking any medications concurrently with Tamiflu.
6. Advise patients to report behavior changes.
7. Follow dosage as indicated by the health-care provider (Vallerand, 2019).

Education/Discharge Instructions

Parents can be instructed to ensure adequate rest, hydration, and nutrition as well as provide fever control as necessary. Continued education includes a reminder of the importance of receiving the influenza vaccine as well as frequent hand washing, covering the mouth and nose when sneezing or coughing, properly disposing used tissues, and avoiding close contact with persons who may have become infected.

Patient Education

Salicylates (Aspirin)

The nurse can instruct the parents to avoid giving salicylates (aspirin) because of the possibility of Reye syndrome. Reye syndrome is an encephalitis-like illness following a viral infection. Reye syndrome is highly associated with the intake of salicylates (aspirin) during the course of the viral disease. The symptoms include nausea, vomiting, lethargy, and indifference; in severe cases, there may be irrational behavior, delirium, and rapid breathing. Warn parents to watch out for these symptoms, especially if aspirin has been given to the patient before consultation.

PULMONARY NONINFECTIOUS IRRITATION

Foreign Body Aspiration

Foreign body (FB) aspiration refers to any solid or liquid substance that becomes caught in the respiratory tract and blocks air passage. Young children are at greater risk of aspirating foreign bodies because of curiosity and the habit of putting things in the mouth. Foreign body aspiration may occur at any age, but it is most common among toddlers. A total of 4,100 deaths from unintentional ingestion or inhalation of food or objects occurred in 2006 (Smith, 2020). The incidence in children from ages 0 to 4 years was 0.5/100,000 population. The most frequently aspirated objects are organic food items such as peanuts, popcorn, hot dogs, or vegetable matter and fruit gel snacks. Nonfood objects include balloons, coins, pen tops, and pins (Burke & Dunn, 2016).

In the child, the aspirated object may stay in the same place of obstruction or move with air. If the child forcefully coughs, the object may be spit out. During the presence of the FB, the bronchioles and bronchi may become larger during inspiration and smaller during expiration. Small objects may cause little damage, and large objects may occlude the whole airway passage, causing more severe symptoms. A sharp object not only blocks the airway but also may lead to severe trauma, and the child may have complications such as inflammation and abscess, atelectasis, and emphysema.

Signs and Symptoms

Signs and symptoms of FB aspiration vary with location.

- Laryngeal FB
  - Rapid onset of hoarseness
  - Chronic, croupy cough
  - Aphonia (inability to speak)
  - Unilateral wheezing
  - Recurrent pneumonia
- Tracheal FB
  - History of brassy cough
  - Hoarseness
  - Dyspnea
  - Possible cyanosis
  - Homophonic wheeze (musical and having the same sound)
  - "Audible slap and palpable thud sound produced by the momentary expiratory effect of the FB at the subglottic level" (Smith, 2020)
- Bronchial FB
  - Most objects are aspirated into the right mainstem bronchus because it is at a less acute angle than the left mainstem bronchus
  - Initial findings similar to those seen in tracheal or laryngeal FB aspiration
  - Blood-streaked sputum
  - Metallic taste (if metallic object was aspirated)
  - May have few initial symptoms if the object did not cause obstruction and was nonirritating
  - Homophonic wheeze
  - Emphysema-like changes result in hyporesonance or hyperresonance
  - Diminished breath sounds
  - Crackles, rhonchi, and wheezes

The child's condition may worsen with total obstruction, and the child may become cyanotic or unconscious. Delay in removal of the FB may be fatal.

Diagnosis

The child's history and physical signs help in the diagnosis of FB aspiration. In children, an FB is suspected in the presence of acute or chronic pulmonary lesions. The nurse can communicate to the family that an x-ray examination with fluoroscopic examination can be helpful in locating the site of the aspirated object. Definitive diagnosis of FB aspiration is through bronchoscopic examination.

Prevention

Prevention of foreign body aspiration includes educating parents and caregivers. Parents are instructed to avoid giving nuts, uncooked carrots, or other foods that are broken into pieces to infants and children before the molars have erupted. In addition, balloons, marbles, coins, tiny toys, or toys with small pieces (e.g., button eyes or beads are not to be given to small children). Instruct parents to keep toxic substances out of the reach of young children. Force feeding is also to be avoided.

Collaborative Care

NURSING CARE

In the hospital, the nurse must closely monitor the child's vital signs and assess the level of consciousness. The nurse can explain any procedures to the parents to help allay anxieties. Initially, the child may be placed on "nothing by mouth" status, and the family is encouraged to follow the medical regimen. The nurse can provide a cool-mist vaporizer and administer antibiotic therapy if deemed appropriate.

The nurse, especially in the community, plays a very important role in foreign body aspiration because the community nurse is involved in health care in the home setting where the accidents commonly occur. In the community setting, the nurse must be skillful in the Heimlich maneuver and can provide health education to parents regarding the procedure.

MEDICAL CARE

If a large object has been swallowed, it may be difficult for the child to remove the FB spontaneously by coughing. In this case, the child will need instrumental assistance to remove the obstruction. The nurse understands that delays in the treatment may lead to swelling in the obstructed site and inflammation may set in, hampering the removal of the object. The FB may also adhere to the lumen of the air passage.

Medical management involves the removal of FBs from the respiratory tract by direct laryngoscopy or bronchoscopy. The child is hospitalized during and after the procedure for observation of laryngeal edema and respiratory distress.

Education/Discharge Instructions

Parents can be taught about safety precautions to avoid FB aspiration. For example, the nurse can communicate to the parents that toys must not have small detachable parts and food should be cut into small bits appropriate for the child's age.

RESPIRATORY CONDITIONS RELATED TO ALLERGENS

Allergic Rhinitis

Allergic rhinitis is an inflammation of the nasal membranes predominantly in the child's nose and eyes. Airborne particles of dust, dander, or plant pollens in children who are allergic to these substances cause allergic rhinitis. It appears alone or in combination with a cold.

Inflammation of the mucous membranes is characterized by a complex interaction of inflammatory mediators and is triggered by an immunoglobulin E (IgE)-mediated response to an extrinsic protein. Mediators are immediately released, including histamine, tryptase, chymase, kinins, and heparin. The mast cells quickly synthesize other mediators including leukotrienes and prostaglandin D_2. These mediators create the symptoms of rhinorrhea.

Mucous glands are stimulated, leading to an increase of secretions produced. Vasodilation then leads to congestion and pressure. Sensory nerves are also stimulated, leading to sneezing and itching. This sequel happens in a matter of minutes and is called the early phase response.

In the next 4 to 8 hours, a complex interplay of neutrophils, eosinophils, lymphocytes, and macrophages occurs. This interaction brings about continued inflammation, termed as the late phase response. The phase may persist for days, and systemic effects range from fatigue to sleepiness to malaise to generalized weakness.

Signs and Symptoms

- Mouth breathing, snoring, and nasal speech
- Clear, thin, watery rhinorrhea
- Nasal congestion and inflammation
- Bogginess of the nasal mucous membranes—may appear pale to purplish
- Nasal crease—horizontal crease across the lower third of the nose
- Itching or rubbing nose referred to as an "allergic salute"
- Nasal stuffiness and postnasal drip
- Sneezing
- Congested cough or night cough
- Itching palate, pharynx, nose, or eyes
- Hoarseness and frequent attempts to clear the throat
- Redness of the conjunctiva, tearing, and edema of the lid and periorbital area
- Allergic shiners (dark periorbital swelling)
- Enlarged tonsils and adenoids
- Cobblestone appearance of pharynx and/or palpebral conjunctivae
- Fatigue
- School performance issues related to lack of sleep
- Dennie lines, Morgan fold, or atopic pleats—extra groove in lower eyelid (Venes, 2017)

Diagnosis

A thorough history and physical examination of the child confirm allergic rhinitis. A nasal smear is done to determine the number of eosinophils in the nasal secretions. A radioallergosorbent test is done to determine specific IgE antibodies. Skin testing is often done to identify the specific allergen.

Prevention

The key to preventing an allergic rhinitis is in learning to avoid known allergens. Strategies for controlling exposure include the following:

- Avoiding exposure to tobacco smoke
- To avoid dust mites, use pillow and mattress covers, wash bed linens weekly in 130°F (54.4°C) water, remove stuffed animals from the bedroom, replace bedroom curtains with blinds, remove carpet from bedroom, and wet mop solid surface floors weekly
- Remove pets from the home
- Repair water leaks; reduce indoor humidity to less than 50%
- Avoid outdoor activity when pollution, mold, and pollen levels are high

Collaborative Care

NURSING CARE

Nursing care is primarily directed toward providing supportive care and educating the family about the illness and management. Supportive care includes ensuring rest, nutrition, and adequate hydration, which will help in thinning secretions.

MEDICAL CARE

Treatment for allergic rhinitis in the child involves pharmacological management. Pharmacological management includes short-acting antihistamines, longer acting histamines, nasal corticosteroid sprays, decongestants, and leukotriene inhibitors. Evidence recommends the use of high-dose allergy shots if the allergen cannot be removed and the child's symptoms are hard to control. This includes regular injections of the allergen in increasing doses, which help the body to adjust to the allergen and prevent the severe reaction.

Education/Discharge Instructions

Education includes giving instruction on environmental control strategies as noted under prevention. In addition, the nurse reviews the prescribed medications with the parents and patient, giving instructions for use in the case of inhalers or internasal sprays, as well as reviewing dosage, common side effects, and contradictions.

Patient Education

Avoiding Allergic Triggers

Education about environmental control measures involves both the avoidance of known allergens (substances to which the patient has IgE-mediated sensitivity) and the avoidance of nonspecific irritants and triggers. In the clinic setting, the nurse can explore possible allergens of the child with the parents to obtain important information that might determine the cause of the allergic rhinitis. Parents must understand the possible complications that allergic rhinitis may cause. These complications range from otitis media, eustachian tube dysfunction, and acute sinusitis to chronic sinusitis.

Asthma

Asthma is the most common chronic disease in childhood and is characterized by the triad symptoms of bronchial smooth muscle spasm, inflammation and edema of the bronchial mucosa, and production and retention of thick, tenacious, pulmonary secretions leading to airway obstruction. Asthma is the most common chronic condition among children, currently affecting an estimated 6.7 million children under 18 years, of which 3.5 million suffered from an asthma attack or episode in 2016 (Szefler et al., 2019). Prevalence and mortality rates are higher and continue to rise among minority and inner-city children. Risk factors include environmental factors, such as air pollutants, allergen exposure, exposure to tobacco smoke, and strong chemical odors. Other factors include low socioeconomic status and health-care disparities (Redjal, 2020). An asthma episode is a series of events that result in narrowed airways. These include swelling of the airway lining, tightening of the muscle surrounding the airways, and increased secretion of mucus inside the airway. The narrowed airway causes difficulty breathing and the familiar "wheeze". The term **status asthmaticus** is used to refer to persistent and intractable asthma exacerbation in which the child does not respond to therapy and is a medical emergency.

Genetic, environmental/extrinsic, and intrinsic factors predispose the child to develop asthma. Although allergens play an important role in asthma, 20% to 40% of children with asthma have no evidence of allergic disease. Among the extrinsic factors are allergens such as dust, pollen, animal hairs, chemical sprays, perfumes, baby powder, molds, and foods such as nuts, chocolates, oranges, and chicken. Conditions such as changes in weather, pollution, and smoke may also trigger an attack. Intrinsic factors include exercise, anxiety, strong emotions such as fear and laughter, and infections.

When any of the factors trigger an asthma attack, the response comes in 10 to 20 minutes. The allergen/antigen binds to the allergen-specific immunoglobulin E (IgE) surface, causing activation of resident airway mast cells and macrophages. Proinflammatory mediators, such as histamine and leukotrienes, are released. They provoke contraction of the airway's smooth muscles, increased mucus secretion, and vasodilation. Consequently, microvascular leakage and exudation of plasma into the airway walls cause them to become thickened and edematous with subsequent lumen constriction (Smith, 2018).

Signs and Symptoms

- Recurrent wheezing
- Shortness of breath
- Nonproductive cough
- Chest tightness or pain
- Exercise intolerance
- Prolonged expiratory phase of respirations
- Tachypnea
- Retractions and nasal flaring
- History of allergies
- History of atopic dermatitis
- Nasal polyps
- History of nighttime cough
- Family history of atopy (asthma, allergic rhinitis, or atopic dermatitis)

Diagnosis

The asthma diagnosis for the child is based on clinical symptoms, history, physical examination, and to a lesser extent, laboratory tests. Diagnostic studies may include pulse oximetry to measure oxygen saturation, blood gases to determine carbon dioxide retention and hypoxemia, complete blood count, pulmonary function tests to assist in determining the degree of disease, peak expiratory flow rate, allergy testing, and chest radiography to evaluate hyperinflation and the potential for coexisting infection (Smith, 2018).

Labs

Blood Gases

Blood gases are used to evaluate respiratory and metabolic functioning through determining the acid-base balance of the blood by the measurement of oxygen and carbon dioxide. Blood gases may be obtained through arterial, venous, capillary, or cord blood. Normal values vary depending on the source. During normal metabolic processes, oxygen is used and carbon dioxide is produced. Various disease conditions affect the levels of each gas in different ways. Blood gas measurements provide information that may help the primary care provider manage metabolic or respiratory disorders. Arterial blood gases measure the amount of dissolved oxygen and carbon dioxide present in arterial blood and reveal the acid-base state and how well the oxygen is being carried to the body. Common measures obtained from blood gases include pH, which measures free H^+ (hydrogen) ion concentration in the circulating blood. The pH is regulated and the acid-base ratio maintained through the work of the lungs and kidneys. The pH is elevated (alkaline) in respiratory or metabolic alkalosis and decreased (acid) in the case of respiratory or metabolic acidosis. The amount of carbon dioxide in

the blood is determined by the partial pressure of carbon dioxide (P_{CO_2}) measurement. The P_{CO_2} is primarily controlled by the lungs. As the CO_2 level increases, the pH decreases. The lungs also help compensate for metabolic disturbances. HCO_3^- represents the bicarbonate ion. As the HCO_3^- level increases so also does the pH. The amount of oxygen dissolved in the blood is measured by the partial pressure of oxygen (P_{O_2}) measurement. The amount of oxygen bound to hemoglobin is determined by oxygen saturation (O_2Sat).

Prevention

Prevention is directed toward day-to-day management of asthma. This includes educating the parents and child on the importance of identifying environmental factors that trigger an attack; compliance with medication; and how to use and clean inhalers, spacer devices, or aerosol equipment as needed. In addition, parents and children need to understand how to manage asthma in settings away from home, how to recognize when there is a need to seek additional assistance, and the importance of regular follow-up.

Collaborative Care

NURSING CARE

Nursing care for children with asthma involves assisting with relief of symptoms and providing health education to patients and family. Asthma attacks are frightening and stressful both for the child and family; therefore, the nurse has a calm approach in its initial management. Administering quick-relief medications without delay is important (Fig. 15-8). Essential nursing interventions include giving medications on time, liquefying secretions through adequate hydration, positioning the child properly (head of bed elevated 30 degrees) to provide comfort, and lung expansion. The side-lying and semiprone positions are also recommended. It is vital that the nurse reports and records the child's respiratory assessment and responses to medications so that appropriate management may be initiated immediately. The nurse can also ensure that respiratory treatments happen in a timely manner and that ordering a prn (as needed) treatment may be necessary.

MEDICAL CARE

Treatment consists of early relief of symptoms through drug therapy and prevention of further attacks through allergen control, environmental manipulation, health education, and attainment of self-management skills. The goal is to enable the child to have as regular a life as possible by keeping the lung function within normal limits. The nurse provides adequate health education about the use of a peak flow meter to help the parents increase their capacity to care for the child.

Drug therapy depends on the level of severity of the disease. There are two approaches to this therapy: (1) the quick-relief or rescue medications and (2) the long-term control medications.

The U.S. Department of Health and Human Services (2017), the National Asthma Education and Prevention Program, expert panel give guidelines for the diagnosis and management of asthma via revised age-related classification schemes for asthma severity (Table 15-2, Table 15-3, and Box 15-1).

FIGURE 15-8 A 3-year-old exhibiting an asthma exacerbation being treated with an albuterol nebulizer in the Pediatric Emergency Department.

The guidelines recommend daily anti-inflammatory agents to control the levels of persistent asthma, with increasing doses of medication as necessary. The use of low-dose control medications, such as inhaled steroids, cromolyn sodium (Intal), nedocromil (Tilade), or an antileukotriene agent such as a montelukast sodium (Singulair) tablet is recommended for children with mild, persistent asthma (Fig. 15-9). A higher dose of steroids with the addition of long-acting beta antagonists may be needed for moderate and severe persistent asthma. For quick relief of bronchospasm and for children with asthma, short-acting inhaled beta antagonists are recommended. For more detailed information of the guidelines visit http://www.nhlbi.nih.gov/guidelines/asthma/index.htm.

Asthma Action Plan

The Asthma Action Plan (Fig. 15-10) is an educational communication tool used between the health-care provider and the patient, along with their family and caregivers, to properly manage asthma and respond to asthma episodes. The Asthma Action Plan is completed by the child's primary care provider. It includes the symptoms and management for each color zone including peak flow measurements appropriate for each color zone. Nurses can provide adequate instructions on how to use, interpret, and complete the form.

A peak flow meter (Fig. 15-11), which can be purchased over the counter, is an essential companion for the Asthma Action Plan for children older than 6 years. The peak flow meter is a portable handheld device that is used to measure

TABLE 15-2

Criteria for Classification of Asthma Severity in Children 0–4 Years of Age

SEVERITY	DAY SYMPTOMS	NIGHT AWAKENINGS	SABA USE*	LIMIT TO ACTIVITY
Intermittent	≤ 2 days/week	None	None	≤ 2 times/week
Mild Persistent	3–6 days/week	1–2 times/month	>2 days/week	Minor
Mod. Persistent	Daily	3–4 times/month	Daily	Some
Severe Persistent	Several times/day	> 1 time/week	Several times/day	Extremely

*Short-acting beta 2 agonists (SABA), such as albuterol, does not include prevention of exercise-induced bronchospasm (EIB).
Source: The U.S. Department of Health and Human Services (2007). National asthma education and prevention program. Expert panel report 3: Guidelines for the diagnosis and management of asthma; Global Initiative for Asthma. Global strategy for asthma management and prevention, 2020. http://www.ginasthma.org.

TABLE 15-3

Criteria for Classification of Asthma Severity in Children 5–11 Years of Age

SEVERITY	DAY SYMPTOMS	NIGHT AWAKENINGS	SABA USE*	LIMIT TO ACTIVITY
Intermittent	≤ 2 days/week	≤ 2 times/month	≤ 2 days/week	None
Mild Persistent	≥2 days/week but not daily	3–4 times/month	≥2 days/week but not daily	Minor limitations
Mod. Persistent	Daily	≥1 times/week but not nightly	Daily	Some limitation
Severe Persistent	Throughout the day	Often nightly	Several times/day	Extremely limited

*Use of short-acting beta 2 agonists (SABA), such as albuterol, does not include prevention of exercise-induced bronchospasm (EIB).
Source: The U.S. Department of Health and Human Services (2007). National asthma education and prevention program. Expert panel report 3: Guidelines for the diagnosis and management of asthma; Global Initiative for Asthma. Global strategy for asthma management and prevention, 2020. http://www.ginasthma.org.

BOX 15-1

Asthma Management Guidelines

Asthma management guidelines have been recently updated. The 2019 Global Initiative for Asthma (GINA) guidelines categorizes asthma severity as mild, moderate, or severe. Severity is assessed retrospectively from the level of treatment required to control symptoms and exacerbations, as follows:

- Mild asthma: Well-controlled with as-needed reliever medication alone or with low-intensity controller treatment such as low-dose inhaled corticosteroids (ICSs), leukotriene receptor antagonists, or chromones.
- Moderate asthma: Well-controlled with low-dose ICS/long-acting beta2-agonists (LABA).
- Severe asthma: Requires high-dose ICS/LABA to prevent it from becoming uncontrolled, or asthma that remains uncontrolled despite this treatment (Morris, 2019).

The 2019 GINA guidelines stress the importance of distinguishing between severe asthma and uncontrolled asthma, as the latter is a much more common reason for persistent symptoms and exacerbations, and it may be more easily improved. The most common problems that need to be excluded before a diagnosis of severe asthma can be made are the following (Morris, 2019):

- Poor inhaler technique
- Poor medication adherence
- Incorrect diagnosis of asthma, with symptoms due to alternative conditions such as upper airway dysfunction, cardiac failure, or lack of fitness
- Comorbidities and complicating conditions such as rhinosinusitis, gastroesophageal reflux, obesity, and obstructive sleep apnea
- Ongoing exposure to sensitizing or irritant agents in the home or work environment

Sources: Global Initiative for Asthma. Global strategy for asthma management and prevention, 2020. http://www.ginasthma.org; Morris, M., Updated Asthma Management Guidelines (2019). Retrieved from https://emedicine.medscape.com/article/296301-guidelines#g2.

the ability to push air out of the lungs. To determine the child's zone for children younger than 6 years, the symptoms alone are used. The "personal best" peak flow is determined when the child is symptom free. A peak flow meter package usually contains a form where peak flow readings are recorded regularly. A personal best normal may be obtained from measuring the patient's own peak flow rate. Therefore, it is important for the patient, parents, and the doctor to discuss what is considered "normal."

Education/Discharge Instructions

Asthma education is critical and is directed at addressing activities discussed in the section on prevention. The community nurse can offer health education to families that emphasizes correctly adhering to the treatment regimen, preventing infection, and avoiding asthma triggers. Nurses are in the best position to provide health education because they are in contact with the patients and the parents most of the time.

PROCEDURE ■ *Using a Peak Flow Meter*

The peak flow meter is a portable handheld device that is used to measure the child's ability to push air out of the lungs.

PURPOSE

The purpose of a peak flow meter is to keep track of the results and help the parents and child to learn about asthma. Keeping a daily record may also help determine whether the child's asthma is getting worse.

EQUIPMENT

- Peak flow meter
- Peak flow record

FOCUS ON SAFETY

Peak Flow Meter

A peak flow meter package usually contains a peak flow record where the peak flow readings are recorded regularly.

TEACH PARENTS

Teach parents about the child's personal best. The "personal best" peak flow is determined when the child is symptom free. It is important for the child, parents, and doctor to discuss what is considered "normal." Remind parents of the need to discuss the readings with the physician.

DOCUMENTATION

01/31/2013 0900 Peak flow meter used. Green Zone, good
control; 80% of personal best, no symptoms noted. Continues to take usual medication.
N. Kramer, RN—C. Kildare RN

FIGURE 15-9 The respiratory therapist helps the child use a metered dose inhaler.

SARS-CoV-2 (COVID-19)

While children with COVID-19 (SARS-CoV-2) may have fewer symptoms than adults, health-care providers caring for children should be aware of the possibility of infection, particularly for infants and children with underlying medical conditions. In the U.S. and globally, fewer children (ages 0-17 years of age) have been affected with COVID-19 than adults. While children comprise 22% of the US population, recent data show that 7.3% of all cases of COVID-19 in the United States reported to CDC were among children (as of August 3, 2020) (CDC, 2020). Hospitalization rates in children are significantly lower than hospitalization rates in adults with COVID-19, suggesting that children may have less severe illness from COVID-19 compared with adults (CDC, 2020).

Symptoms, Diagnosis, and Severity of COVID-19 in Children

Nonrespiratory symptoms of COVID-19—such as GI symptoms (e.g., nausea, vomiting, diarrhea), neurological symptoms (e.g., anosmia, ageusia, headache), or fatigue or body and muscle aches—may appear before fever and lower respiratory tract symptoms (e.g., cough and shortness of breath).

The incubation period of SARS-CoV-2 appears to be about the same for children as in adults, at 2 to 14 days with an average of 6 days (CDC, 2020). Comparing trends in pediatric infections before and after the return to in-person school and other activities may provide additional understanding about infections in children.

Treatment

Treatment of COVID-19 in the pediatric populations is largely supportive and strives to prevent secondary infections such as pneumonia. In addition, while initial trials are showing promise for Remdesivir, currently no specific drugs have been approved by the U.S. Food and Drug Administration (FDA) for treatment of COVID-19 for children (CDC, 2020). There is currently no FDA-approved vaccine (although several are in phase III trials and are anticipated to be available for distribution before the end of 2020), or postexposure prophylaxis for people who may have been exposed to SARS-CoV-2.

American Lung Association.

My Asthma Action Plan

Name: _____ DOB: ____ / ____ / _____

Severity Classification: ☐ Intermittent ☐ Mild Persistent ☐ Moderate Persistent ☐ Severe Persistent

Asthma Triggers (list): _____

Peak Flow Meter Personal Best: _____

Green Zone: Doing Well

Symptoms: Breathing is good – No cough or wheeze – Can work and play – Sleeps well at night
Peak Flow Meter _____ (more than 80% of personal best)

Control Medicine(s)	Medicine	How much to take	When and how often to take it

Physical Activity ☐ Use Albuterol/Levalbuterol ____ puffs, 15 minutes before activity
☐ with all activity ☐ when you feel you need it

Yellow Zone: Caution

Symptoms: Some problems breathing – Cough, wheeze, or tight chest – Problems working or playing – Wake at night
Peak Flow Meter _____ to _____ (between 50% and 79% of personal best)

Quick-relief Medicine(s) ☐ Albuterol/Levalbuterol ____ puffs, every 4 hours as needed
Control Medicine(s) ☐ Continue Green Zone medicines
☐ Add _____ ☐ Change to _____

You should feel better within 20–60 minutes of the quick-relief treatment. If you are getting worse or are in the Yellow Zone for more than 24 hours, THEN follow the instructions in the RED ZONE and call the doctor right away!

Red Zone: Get Help Now!

Symptoms: Lots of problems breathing – Cannot work or play – Getting worse instead of better – Medicine is not helping
Peak Flow Meter _____ (less than 50% of personal best)

Take Quick-relief Medicine NOW! ☐ Albuterol/Levalbuterol ____ puffs, _____ (how frequently)
Call 911 immediately if the following danger signs are present:
- Trouble walking/talking due to shortness of breath
- Lips or fingernails are blue
- Still in the red zone after 15 minutes

Emergency Contact Name _____ Phone (____) _____ - _____
Emergency Contact Name _____ Phone (____) _____ - _____

Date: ____ / ____ / _____

1-800-LUNGUSA | Lung.org

ALA Asthma AP V1 3 18 2020

FIGURE 15-10 Asthma Action Plan. Source: Used with permission from American Lung Association, © 2020.

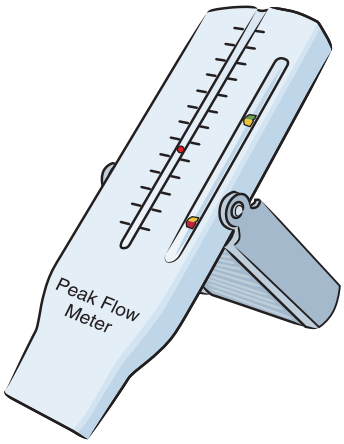

FIGURE 15-11 Peak flow meter.

SUMMARY POINTS

- The differences between the adult and child respiratory system affect function and subsequent respiratory conditions.
- It is essential that the nurse has a good understanding of congenital respiratory conditions and structural anomalies in children, along with an understanding of signs and symptoms and prescribed treatment.
- Nurses must provide adequate emotional support to parents whose children have life-threatening respiratory conditions.
- The diagnosis, signs and symptoms, and nursing care measures are important in caring for children with respiratory conditions.
- Nursing care for children with infectious respiratory conditions includes close monitoring and correct treatment to prevent spread of infection.
- Nursing care for noninfectious respiratory conditions is aimed at managing the upper airway to prevent obstruction and further damage.
- During health teachings, nurses emphasize to parents an awareness of the ill effects of the different forms of air pollutants, including environmental tobacco.
- The goal for children with asthma is to enable the child to have as normal of a life as possible by keeping the lung functioning within normal limits.
- The nurse can educate the family about the benefits of the child wearing a medical alert bracelet.

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CONCEPT MAP

Caring for the Child With a Respiratory Condition

Oxygenation:
- Pulse oximetry
- Arterial blood gases

Function:
- Pulmonary function test
- Slow vital capacity
- Lung volume and capacity

Radiological:
- X-rays
- CT scan
- Fluoroscopy

Visualization:
- Laryngoscopy
- Bronchoscopy
- Thoracoscopy
- Endoscopy
- Otoscopy

Lab Studies:
- Lung tissue biopsy
- Blood cultures

Could Precipitate a Condition:
- Smaller nares
- Epiglottis: longer, higher, flaccid
- Trachea: shorter, narrower, higher bifurcation
- Increased friction and resistance → difficult ventilation
- Lung tissue immature at birth
- < 6 yrs: abdominal breather
- Less mature immune system

Infectious Conditions:
- Pertussis/whooping cough
- Tuberculosis
- Influenza

Noninfectious Irritation:
- Foreign body aspiration
- Smoke inhalation injury

Upper Airway Disorders:
- Sinusitis/nasopharyngitis/pharyngitis/epiglottitis
- Tonsillitis
- Croup/laryngotracheobronchitis
- Otitis media/externa

Lower Airway Disorders:
- Bronchitis
- Pneumonias
- SARS
- Bronchiolitis/RSV

Congenital Conditions/Structural Anomalies:
- Choanal atresia
- Esophageal atresia and TEF
- Diaphragmatic hernia
- ARDS
- Bronchopulmonary dysplasia
- Cystic fibrosis

Disorders Related to Allergens:
- Allergic rhinitis
- Asthma

General Potential Nursing Care:
- Assessment: airway patency; color; LOC; cardiac assessment; posture; respiratory rate; chest symmetry percussion/palpation; auscultation; sputum
- Promote adequate oxygenation: clean nasal area; suction; chest PT; vaporizer; oximetry/ABG results; CPAP/mechanical ventilation; stat rx for asthma
- Aspiration precautions; watch feeding position
- Monitor vital signs
- Maintain adequate nutrition and fluid balance
- Protect against infection; hand washing
- Infection processes: possible strict isolation; antibiotic therapy; prevent transmission

Nursing Insight:
- Know the different signs and symptoms between mild, moderate and severe respiratory distress
- Avoid use of salicylates for fever due to potential for Reye syndrome
- Otitis media occurs less in breastfed infants
- RSV-IGIV can prevent RSV

Collaboration in Caring:
- Encourage parents to learn the Heimlich maneuver