ASSISTING IN PULMONARY MEDICINE

SCENARIO

Michael McGuire, CMA (AAMA), works for a primary care physician, Dr. John Samuelson, in the small town in which he grew up. Dr. Samuelson’s practice is open to all patients, but a large number of individuals with respiratory disease seek his help in managing their pulmonary problems. In the 6 months since he started with the practice, Michael has learned how to assist with pulmonary diagnostic tests and the special needs of patients with respiratory diseases.

Michael has become familiar with the diagnosis and treatment of many common pulmonary problems and adept at accurately documenting respiratory system signs and symptoms. Many of Dr. Samuelson’s patients smoke cigarettes, and the main employers in the community are coal mining and construction companies, so many patients are at risk for smoking and occupation-related respiratory problems.

While studying this chapter, think about the following questions:

- What are the common pathologic conditions of the pulmonary system?
- What clinical skills are required in this specialty practice?
- What medical terms must Michael know to identify and explain these patient disorders?
- What pulmonary complications are associated with smoking and occupational respiratory hazards?
- What are the medical assistant’s primary responsibilities in working with patients with pulmonary problems?
- What diagnostic and treatment procedures typically are used in a pulmonary practice?

LEARNING OBJECTIVES

1. Define, spell, and pronounce the terms listed in the vocabulary.
2. Apply critical thinking skills in performing the patient assessment and patient care.
3. Describe the organs of the respiratory system and their functions.
4. Explain the process of ventilation.
5. Use correct respiratory system terminology when documenting procedures.
6. Compare and contrast infections and inflammations of the respiratory system.
7. Describe the diagnosis and treatment of tuberculosis.
8. Summarize the disorders associated with chronic obstructive pulmonary disease and their treatments.
9. Teach a patient how to use a peak flow meter.
11. Detail patient teaching for the use of a metered-dose inhaler.
12. Describe the cancers associated with the respiratory system.
13. Distinguish among common diagnostic procedures for the respiratory system.
15. Correctly use a pulse oximeter.
16. Collect a sputum sample for culture.
**VOCABULARY**

*bifurcates* Divides from one into two branches.

*bronchiectasis* (brong’-ke-ek-ruh-sis) Dilation of the bronchi and bronchioles associated with secondary infection or ciliary dysfunction.

*chronic bronchitis* Recurrence: inflammation of the membranes lining the bronchial tubes.

*cilia* (sil’-e-uh) Hairlike projections capable of movement; in the lungs, cilia waves move unwanted substances upward, such as mucus, dust, and pus; cilia are destroyed by smoking.

*hypercapnia* (hi-per-kap’-ne-uh) Excess levels of carbon dioxide in the blood.

*pulmonary consolidation* In pneumonia, the process by which the lungs become solidified as they fill with exudates.

*rhinorrhea* (ri-no-ruh-uh) The discharge of nasal drainage.

*tubercle* (too’-bur-kuh) A nodule produced by the tuberculosis bacillus.

*tracheostomy* (tra-ke-os’-ruh-me) A surgical opening made through the neck into the trachea to allow breathing.

*virulent* (vir’-u-lent) Exceedingly pathogenic, noxious, or deadly.

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The respiratory system has two primary functions. The first is to exchange oxygen from the atmosphere for carbon dioxide waste. The two types of respiration are *external respiration*, which brings oxygen into the lungs, where carbon dioxide exchange occurs in the blood vessels surrounding the alveoli, and *internal respiration*, in which oxygen is exchanged for carbon dioxide at the cellular level. Cells soon stop functioning and die if they are deprived of oxygen.

The second function of the respiratory system is to maintain the acid-base balance in the body. Failure of this function may result in respiratory acidosis or alkalosis. Respiratory acidosis occurs if the patient experiences hypoventilation and carbon dioxide levels increase in the body, causing *hypercapnia*. Respiratory alkalosis is related to an excess release of carbon dioxide caused by hyperventilation, which may be associated with anxiety or an acute asthma attack. Both conditions can be life-threatening if the underlying causes are not corrected. The respiratory and circulatory systems work together to supply body cells with oxygen and remove metabolic wastes. The ventilation process is controlled by the respiratory center in the central nervous system and assisted by the intercostal muscles and the diaphragm.

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**THE RESPIRATORY SYSTEM**

The thoracic cage, sometimes called the *rib cage*, is a bony structure that is narrower at the top and wider at the base. It is held in place by the thoracic vertebrae of the spine in the center of the back and by the sternum in the center of the anterior aspect of the body. The first seven ribs attach directly to the sternum and are called the *true ribs*. Ribs 8, 9, and 10 fasten one to another, forming the false ribs, and ribs 11 and 12 are the “floating” ribs, or half ribs, because their only attachment is to the thoracic vertebrae. At the base or floor of the rib cage is the diaphragm, a musculotendinous membrane that separates the thoracic cavity and the abdominal cavity (Figure 46-1). The respiratory system is divided into two anatomic regions, the upper respiratory tract and the lower respiratory tract.

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**REQUIREMENTS FOR NORMAL RESPIRATION**

- An open airway leading to the lungs
- Ability of the lungs to expand rhythmically
- Intact alveolar membranes
- Coordination of the intercostal muscles and the diaphragm
- Proper action of the central nervous system’s respiratory control center

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**Upper Respiratory Tract**

The upper respiratory tract, which transports air from the atmosphere to the lungs, includes the nose, pharynx (throat), and larynx (Figure 46-2). As air enters the nasal cavity, it is cleaned by the *cilia*, warmed by capillary blood vessels, and moistened by mucous membranes. The paranasal sinuses, hollow cavities that also are lined with mucous cells and cilia, open into the nasal cavity and help warm and moisten inhaled air. The filtered, warmed, and moistened air moves past the tonsils, which have an immunity function and help defend the body from potential pathogens, and through the pharynx. As the air continues toward the lungs, it passes through the larynx. The opening into the larynx is protected by a movable piece of cartilage, the epiglottis. The larynx, or voice box, is made up of vocal cords, which vibrate when air is exhaled, creating the sound of the voice. Once the air passes through the larynx, it enters the lower respiratory tract.

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**Lower Respiratory Tract**

The lower respiratory tract consists of the trachea, bronchial tubes, and lungs (see Figure 46-2). These structures are also lined with mucous tissue that is covered with cilia. The collection of dust and foreign particles in the cilia initiates the coughing reflex; this helps expectorate mucus, which may contain pathogens. Without these defense mechanisms, pathogens would remain in the lungs and may cause disease. Cigarette smoke and other air pollutants slow or paralyze the cleansing action of the cilia and damage the mucous membrane lining throughout the respiratory tract.

The trachea (windpipe) is a tube that begins at the larynx and extends into the center of the chest, where it divides, or *bifurcates*...
cates, into the right and left bronchi. It is about 5 inches long and is surrounded by C-shaped cartilaginous rings. These rings hold the trachea open regardless of changes in air pressure.

It is often said that the bronchial tubes look like a tree hanging in the chest (Figure 46-3). The right bronchus is wider than the left to accommodate the right lung lobes, which also are larger.

This means that foreign substances are more frequently seen in the right bronchus. Once the bronchi enter the lungs, they branch into smaller and smaller passageways, much as blood vessels do in the circulatory system. This branching continues until it becomes microscopic. These very tiny bronchi are called bronchioles. Every bronchiole terminates in microscopic air sacs.
called alveoli. The alveoli are made of thin tissue, only one cell wall thick, that allows for the exchange of oxygen and carbon dioxide through the cell membrane.

The bronchial tree and alveoli are the major structures housed within the right and left lungs. The lungs are soft and spongy because of the air sacs that make up most of their mass. They hang in the right and left sides of the chest, separated by the pericardial sac, which contains the heart. The right lung is divided into three lobes and has a greater volume capacity than the left lung. Because each lobe has its own bronchus and blood supply, the removal of one lobe (lobectomy) results in little or no damage to the rest of the lung. The left lung is longer and narrower and has a distinct indentation in its center, known as the cardiac notch, where the left ventricle of the heart is located and an apical pulse is heard. The left lung has only two lobes, the upper and lower sections (Figure 46-4).

Each lung is encased in a double-layered sac called the pleural membrane. The membrane closest to the lung is called the visceral pleura, which doubles back to form the parietal pleural membrane. Small amounts of pleural fluid fill the space between the two membranes and provide lubrication for the movement of the lungs during inhalation and exhalation.

**VENTILATION**

In the very delicate lung tissue, the bronchioles deposit oxygenated air into the grapelike structures of the alveoli. Surrounding each alveolus is a network of pulmonary capillaries filled with waste air. The oxygenated air moves through the single-celled walls of the alveoli and into the single-celled walls of the pulmonary capillaries (Figure 46-5). As this is happening, the waste air is forced out of the capillaries, into the alveoli, and then into the bronchioles. This carbon dioxide–oxygen exchange provides oxygen-rich blood that is returned to the heart for distribution throughout the body; carbon dioxide wastes are excreted with exhalation. The process involved in this gaseous exchange is called ventilation. The movement of oxygen from the atmosphere into the alveoli is known as inspiration, and the movement of waste gases from the alveoli into the atmosphere is called expiration.

**Inspiration**

Inspiration begins with a signal from the medulla oblongata in the brainstem. The signal originates because of a decrease in blood oxygen levels or an increase in carbon dioxide levels. The stimulus is carried by the phrenic nerve to the major muscle of inspiration, the diaphragm. When the diaphragm receives the signal, it flattens out and pulls downward. At the same moment, the intercostal muscles between the ribs contract, causing the ribs to move outward and the chest cavity to enlarge. This movement
causes the lungs to expand and increase their volume. The more these muscles are contracted, the deeper the inhalation is and the greater the air volume becomes. Respiratory distress occurs when an individual is unable to move an adequate amount of air into the lungs, using the diaphragm and intercostal muscles, to meet the body’s needs.

### Expiration

The second half of ventilation is expiration. Once inspiration is complete, the diaphragm and intercostal muscles relax, causing the diaphragm to move upward into the thoracic cavity and the ribs to move inward, reducing lung capacity. This movement forces the waste air out of the lungs and back into the atmosphere. Expiration requires very little energy and takes place with minimal effort by the body. However, in certain respiratory conditions, such as asthma or emphysema, the person has difficulty getting air out of the lungs, and accessory muscles in the chest and abdomen are needed to assist the intercostal and diaphragm muscles for complete exhalation.

### Respiratory System Defenses

Every part of the respiratory system has a defense mechanism. In the upper respiratory tract, the mucus-covered ciliated surface of the mucous membranes trap particles through the continuous flow of the mucus back toward the nasopharynx; the particles are either sneezed outward or swallowed.

The lower respiratory tract is sterile, which is phenomenal considering that each day these airways are exposed to approximately 10,000 L of air containing an endless number of microorganisms and foreign material. The ever-changing airflow, inspiration to expiration, creates a turbulence that makes remaining in the bronchi very difficult for these invading substances. This, combined with coughing, sneezing, and a functioning immune system, protects the respiratory tract and helps the body maintain homeostasis. Disease occurs when something disrupts the normal homeostatic chain of events.

### Table 46-1 Respiratory System Terms

<table>
<thead>
<tr>
<th>MEDICAL TERM</th>
<th>DEFINITION</th>
</tr>
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<tbody>
<tr>
<td>Apnea</td>
<td>Absence of breathing</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>Collapsed lung</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>Difficulty breathing</td>
</tr>
<tr>
<td>Empyema</td>
<td>Accumulation of pus in the pleural space</td>
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<tr>
<td>Hemoptysis</td>
<td>Expectoration of blood</td>
</tr>
<tr>
<td>Hemotherax</td>
<td>Accumulation of blood and fluid in the pleural cavity</td>
</tr>
<tr>
<td>Hypercapnia</td>
<td>Greater than normal amounts of carbon dioxide in the blood</td>
</tr>
<tr>
<td>Hyperpnea</td>
<td>Deep, rapid, labored respiration that may occur because of exercise or pain and fever</td>
</tr>
<tr>
<td>Hypoxemia</td>
<td>Low level of oxygen in the blood</td>
</tr>
<tr>
<td>Orthopnea</td>
<td>Person must sit or stand to breathe comfortably</td>
</tr>
<tr>
<td>Pleurisy</td>
<td>Inflammation of the parietal pleura, causing dyspnea and stubborn pain; friction rub may be auscultated</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>Collapse of the lung as a result of the collection of air or gas in the pleural space</td>
</tr>
<tr>
<td>Pyothorax</td>
<td>Collection of pus in the pleural cavity caused by infection</td>
</tr>
<tr>
<td>Rales</td>
<td>Bubbling or popping sound heard on auscultation; it is produced by the passage of air through bronchi that are constricted or contain secretions</td>
</tr>
<tr>
<td>Rhinoplasty</td>
<td>Plastic surgery to repair or alter the structure of the nose</td>
</tr>
<tr>
<td>Rhinorrhea</td>
<td>Excessive drainage from the nose</td>
</tr>
<tr>
<td>Rhonchi</td>
<td>Continuous rumbling sound heard on auscultation; it is caused by thick secretions or spasmis</td>
</tr>
<tr>
<td>Tachypnea</td>
<td>Abnormally rapid rate of breathing</td>
</tr>
<tr>
<td>Thoracotomy</td>
<td>Surgical opening into the thoracic cavity</td>
</tr>
</tbody>
</table>

### Major Diseases of the Respiratory System

Many diseases affect the respiratory system. The major ones can be divided into infectious diseases, obstructive disorders, and tumors. Respiratory diseases cause common symptoms, including sneezing, a productive or nonproductive cough, sore throat or hoarseness, fever, general malaise, altered breath sounds, and changes in breathing patterns. The medical assistant must be familiar with common respiratory terms and use them in documenting a patient’s signs and symptoms (Table 46-1).

### Critical Thinking Application 46-1

Michael is taking a patient history for a new patient, who reports the following problems: difficulty breathing; sometimes she has to sit up to breathe comfortably; occasionally she coughs up blood and has excessive nasal drainage. Six months ago, she experienced very rapid breathing and a blue color to her skin, so she was admitted to the hospital and diagnosed with blood and fluid around her right lung, which had become infected, causing her lung to collapse. Based on what Michael knows about respiratory system terminology, how should he document this information?
Infectious Diseases

Respiratory tract infections fall into two categories, depending on their location. Diseases of the nose and upper respiratory tract are more common than diseases of the lower respiratory tract (e.g., pneumonia). Respiratory tract infections account for approximately 75% of all clinically diagnosed infections. Only about 5% of these infections involve the lungs. Most lung infections are seen in hospitalized patients, the elderly, substance abusers, alcoholics, and patients with acquired immunodeficiency syndrome (AIDS). Pneumonia is the seventh leading cause of death in the United States and often is the cause of death for debilitated people.

Upper Respiratory Tract Infections

Common Cold. The common cold was discussed in Chapter 42 as an acute inflammatory process affecting the mucous membranes that line the nose, pharynx, larynx, and bronchus. Usually the term “cold” is used when only the membranes of the nose and pharynx are affected; however, the same virus can affect the larynx and lungs. The viral invasion can be followed by bacterial infections of the pharynx, sinuses, and middle ear. Common signs of an upper respiratory tract infection (URTl or URI) include nasal congestion and rhinitis, sneezing, watery eyes, pharyngitis (sore throat), laryngitis (hoarseness), and coughing. Nasal discharge usually is clear and watery in the early stage but can become greenish yellow as the virus becomes more virulent or when bacteria invade. The patient usually complains of headache, low-grade fever, chills, and anorexia.

Currently there is no cure for the common cold; the infection usually runs its course in 3 to 5 days. The best way to treat it is to get plenty of rest and drink fluids. An over-the-counter (OTC) cold remedy, cough syrup, and acetaminophen may lessen the discomfort of cold-related symptoms. Antibiotics are prescribed only if evidence of a secondary bacterial infection is present. As discussed in Chapter 33, although echinacea may be promoted as an effective preventive and/or treatment for the common cold, most studies show little or no evidence that it is effective.

Sinusitis. The paranasal sinuses are air-filled spaces in the skull located in the brow area over the eyes, inside each cheekbone, behind the bridge of the nose, and behind the eyes. Each sinus has an opening into the nose for the free exchange of air and is lined with a continuous mucous membrane. Healthy sinuses are sterile, but an infection or an allergic reaction can cause one or more of the sinuses to become inflamed or infected. Inflammation causes edema and the collection of mucus within the sinus cavity, creating a feeling of pressure, nasal congestion or rhinitis, and classic sinus headaches. The location of sinus pain depends on the sinus cavity involved but can be described as pain in the forehead (frontal sinuses), upper jaw and teeth discomfort (maxillary sinuses), pain between the eyes (ethmoid sinuses), and/or an earache and neck pain (sphenoid sinuses). The condition is treated with decongestants, antibiotics for bacterial infections, and analgesics. Sinusitis can be acute, lasting 2 to 8 weeks, or chronic, with symptoms lingering much longer.

Allergic Rhinitis (Hay Fever). Although not caused by a pathogenic organism, allergic rhinitis frequently is confused with infectious disease. This disorder affects millions of people every year. It is caused by a reaction of the nasal mucosa to an environmental allergen. The most common allergen is plant pollen; this is where the term “hay fever” originated. Signs and symptoms include sneezing, nasal congestion, nasal itching, and rhinitis. Symptoms can be controlled either with OTC treatments, such as Sudafed and Zyrtec or with prescription antihistamines, such as fexofenadine: hydrochloride (Allegra), montelukast (Singulair), and fluticasone (Flonase) and cromolyn sodium (Nascrom) nasal sprays. The list of possible allergens is extensive. When this condition is seen in the respiratory practice, the patient usually is referred to an allergist for testing and possible immunotherapy.

Patients may have difficulty determining whether symptoms are caused by a cold or an allergy. The condition usually is an allergy if the eyes, ears, nose, throat, and roof of the mouth (palate) are itchy; the eyes are red and watery; a clear, thin nasal discharge is present; symptoms are seasonal and last for weeks or months; and the individual does not have a fever.

Lower Respiratory Tract Infections

Pneumonia. Pneumonia is both a specific disorder and a general term meaning inflammation of all or part of the lungs (Figure 46-6). Pneumonia can be caused by bacteria, viruses, or other pathogens (Table 46-2). It also can be caused by inhalation of irritants or poisonous gas and by aspiration of solids or fluids into the lungs. The most common causative organisms are staphylococci and streptococci.

Pneumonia can occur in any age group but most often affects preschoolers and the elderly (over age 65). It can range from a mild complication to a life-threatening illness. Risk factors include smoking, alcoholism, and immunosuppression caused by diseases or treatment. The patient usually comes to the office with symptoms of high fever, chills, and general malaise. Signs of the illness include dyspnea, tachypnea, chest pain during inspiration, and a relentless cough with possible hemoptysis. Auscultation of
the chest reveals rales, rhonchi, and other signs of pulmonary consolidation. The infection may spread into the pleural cavity, causing empyema and pleurisy.

The diagnosis is confirmed with a chest x-ray evaluation; sputum culture and sensitivity testing to identify the invading organism and determine the appropriate antibiotic therapy; and a white blood cell (WBC) count, including a differential count to determine whether the pneumonia is viral or bacterial. If the pneumonia is viral, the number of WBCs does not increase; if it is bacterial, the greater the invasion, the higher the WBC count. With bacterial pneumonias, the differential count shows elevated neutrophil and monocyte levels. If the invading organism is bacterial, the treatment of choice is antibiotics and lung function therapy until the patient has recovered. If the organism is viral, the patient is given supportive care, such as antipyretics, fluids, and oxygen, until the immune system can control the spread of the virus.

Tuberculosis. According to the Centers for Disease Control and Prevention (CDC), approximately one third of the world’s population is infected with tuberculosis (TB). TB causes more deaths than any other infectious agent in the world. For more than 50 years, the incidence of TB in the United States steadily declined; however, from the late 1980s through the 1990s, a resurgence in reported cases occurred. This increase was believed to be the result of increased travel and immigration; the number of individuals with AIDS, who have little resistance to disease; an increase in the number of homeless and malnourished people; and the overwhelming proliferation of drug-resistant TB bacilli. An international TB vaccine, bacille Calmette-Guérin (BCG), is available, but it is rarely used in the United States. The vaccine does not always provide protection from the disease and those who are vaccinated may have a positive Mantoux test result.

TB is caused by the bacterium Mycobacterium tuberculosis. This organism is covered with a waxy substance that enables it to survive outside a living host for a long time. It is transmitted by droplets of sputum expectorated into the environment by an infected host that are inhaled by another person. In the warm, moist respiratory tract, these organisms again can become active if the individual is susceptible to the disease. TB also can be spread when an infected person coughs or sneezes, releasing airborne infected droplets, which are inhaled and cause an infection if the person is susceptible.

TB develops in two stages. The primary infection occurs when the person is first infected with the bacteria and the lungs become inflamed. Cell-mediated immunity ensues, isolating the bacteria and forming a tubercle. At this point a healthy individual can stop the spread of infection, causing the TB bacillus in the tubercle to become inactive. In this case, the person was exposed to the pathogen but never developed active disease and is said to have a latent TB infection. Individuals with latent TB are asymptomatic and are not infectious. However, because an exposed person develops antibodies to the disease, he or she consistently tests positive on TB skin screening tests. Therefore, rather than the purified protein derivative (PPD), or Mantoux test, these patients should have chest x-ray studies to diagnose active TB.

At any time the bacilli in the tubercles can be reactivated, and secondary, or active, TB can develop. The patient now is actively infected with the disease, which can spread to the bones, brain, and kidneys (Figure 46-7). Some people develop active TB soon after becoming infected, before the immune systems can fight the TB bacteria; others develop it later in life, when the immune systems are weakened for other reasons.

TB is diagnosed most frequently in people living in crowded conditions with poor hygiene, those who are malnourished, and those who have other chronic conditions. It spreads most rapidly in large cities, in the elderly, alcoholics, and the homeless. Symptoms of an active infection include an intermittent fever that peaks in the afternoon, night sweats, weight loss, and general malaise. As the infection becomes virulent in the host, a productive cough develops, and thick, dark, frequently blood-tinted mucus is expectorated.

The primary diagnosis of TB is established through the patient’s signs and symptoms. The infection is suspected with a positive chest x-ray film but is confirmed with a sputum culture. Traditional culture methods originally took 4 to 6 weeks, and this extended period allowed a potentially infectious individual to continue to spread the disease. New culture techniques identify the bacterium in as little as 36 to 48 hours. The physician may order a blood test, the QuantiFERON-TB Gold test (QFT), to diagnose TB infection. The QFT measures the response to TB proteins when they are mixed with a small amount of blood. A two-step Mantoux test is recommended for individuals who are over age 45 and have never had a Mantoux test; those who have been vaccinated with BCG; and employees of hospitals and long-term care facilities. For this test, the initial intradermal skin test is administered and read in 48 to 72 hours. If the result is negative, a second Mantoux is performed on the opposite arm 1 to 3 weeks after the first test and again read in 48 to 72 hours.

Once a diagnosis of TB has been confirmed, the patient is prescribed long-term treatment with a combination of drugs to eradicate the bacilli. If the patient has tested positive for TB but does not have an active infection, the physician prescribes isoniazid (INH) and rifampin (RIF) for 6 months to treat any possible tubercle formations. If the patient has active pulmonary TB, the CDC recommends a four-drug regimen—INH, RIF, pyrazinamide, and ethambutol—daily for 6 months. The patient is
retested, and pharmaceutical treatment is continued for 3 months after a negative sputum culture has been obtained. It is crucial that patients being treated with TB medications strictly comply with medication orders to prevent the creation of multidrug-resistant TB (MDR-TB). Resistant strains of TB develop because of skipped doses or failure to take the medication as long as prescribed. MDR-TB requires at least 2 years of drug therapy with medications that can cause serious side effects, especially liver damage. All tuberculin-negative healthcare workers should have a PPD annually; workers who show a positive reaction but are not actively infected with TB should have an annual chest x-ray evaluation to screen for the disease.

**Chronic Obstructive Pulmonary Disease**

Chronic obstructive pulmonary disease (COPD) is a group of diseases with the common characteristic of chronic airway obstruction. COPD is the fourth leading cause of death in America, and most of those deaths are related to smoking. Among the diseases in this group are chronic bronchitis, bronchiectasis, asthma, pneumoconiosis, and emphysema. Although the mechanism of the obstruction may vary, a patient with COPD is unable to ventilate the lungs freely, which results in an ineffective exchange of respiratory gases, dyspnea, and productive cough. Over time, eliminating carbon dioxide from the lungs during expiration becomes increasingly difficult.

**Asthma**

Pediatric asthma was addressed in Chapter 42. Asthma attacks occur in response to a number of triggers that cause inflammation and bronchospasm with resultant airflow obstruction. Asthma can develop into a chronic disease characterized by increased activity or sensitivity of the bronchial tubes to external factors, such as environmental irritants, poor air quality, and allergies, or to internal factors, such as stress, exercise, infection, and allergen inhalation. Asthma also has a strong hereditary factor.

Asthma attacks can be mild to severe and can last minutes to days. Bronchospasms trap air in the lungs while the inflammatory
response creates edema and causes secretion of mucus into the constricted bronchioles. A patient with asthma complains of a nonproductive cough, dyspnea, expiratory wheezing, and chest tightness. Because the individual has difficulty breathing, tachycardia, pallor, and diaphoresis also may occur. The patient can speak only a few words at a time, stopping intermittently to regulate air intake. When the chest is auscultated, the physician hears diminished breath sounds with wheezes and rhonchi in the lungs. Spirometry can be used to measure the degree of airflow obstruction. Chest x-ray studies may show changes in the lungs from mucous obstructions. Blood tests include a complete blood cell count with a differential count to determine whether the attack is allergy related.

Regardless of their age, patients with asthma should be actively involved in the day-to-day management of their disease. The medical assistant may be responsible for teaching the patient how to perform peak flow measurements either daily or at the onset of an attack. Peak flow meters assess the individual's ability to move air into and out of the lungs. The physician may want the patient to keep a log of daily peak flow results or to use the instrument as an at-home monitoring device when chest tightness and wheezing occur. The meter measures the peak expiratory flow rate, which is the fastest speed at which the patient can blow air out of the lungs after taking in as big a breath as possible (Procedure 46-1). Peak flow readings provide an evaluation of bronchial function that the patient can perform at home with limited assistance. Readings can help predict an asthma attack if levels are falling; can measure the degree of bronchospasm; and provide the physician with feedback regarding the effectiveness of asthma treatment. The physician uses three zones of measurement to interpret peak flow rates. The green zone is considered normal: the reading is 80% to 100% of normal peak flow rates, indicating the patient's asthma is under control. The yellow zone signals caution: the patient's highest reading is 50% to 80% of normal. The physician makes treatment decisions and recommendations at this point, or the patient may already be instructed on how to manage medications if readings are within these levels. The red zone includes readings below 50% of the normal level, and immediate action must be taken to prevent severe bronchospasms.

If the patient is having an asthma attack, the bronchioles are constricting, becoming edematous, and filling up with mucus, so the patient is unable to exhale strongly enough to raise the peak flow indicator to a normal level. If readings are below normal, the physician prescribes a treatment plan that may include contacting the physician when peak flow levels are below a certain point or starting nebulizer treatments. The physician may recommend an increase in antiinflammatory medication if more than a 20% variation from normal is seen in the readings. The medication therapy chosen depends on the severity and frequency of acute attacks, but management is necessary to prevent permanent lung damage and emphysema-like changes in the lungs.

The treatment of asthma consists of a regimen of medications, including "rescue" inhalers (e.g., ipratropium bromide [Atrovent] or albuterol [Ventolin]), which are used to relieve bronchospasms or for exercise-induced asthma (Figure 46-8). Tissue inflammation can be treated with steroid inhalers (e.g., flunisolide [Aerobid], triamcinolone acetonide [Azmacort]), or fluticasone [Flovent Diskus]) and/or an oral leukotriene-receptor antagonists such as zafirlukast (Accolate) or montelukast sodium (Singular), taken on a regular basis. A severe attack may require injections of epinephrine, oral corticosteroids (prednisone), and/or nebulizer treatments with a bronchodilator (Procedure 46-2). A nebulizer forces compressed air through a medication chamber that converts liquid medication (albuterol or budesonide [Pulmicort]) into an aerosol or mist form that can be inhaled though a mask or mouthpiece.

The physician prescribes an inhaler dose according to the number of "puffs" of a metered-dose inhaler (MDI) the patient should administer. MDIs consist of a pressurized canister containing medication and a mouthpiece. Most MDIs hold about 200 doses of medication combined with a pressurized gas propellant, which forces the drug out of the canister. When the canister is inverted and depressed, a metered dose (premeasured) is delivered through the mouthpiece in aerosol form. Patient teaching is very important to ensure that the patient operates the device correctly so that the medication can be administered as ordered. If both a steroid and a bronchodilator have been prescribed, the bronchodilator should be taken first, because this opens the airways so that the steroid is better distributed throughout the lungs.
**PROCEDURE 46-1**

**Instruct Patients According to Their Needs: Teach a Patient to Use a Peak Flow Meter**

**GOAL:** To instruct the patient in the proper method of performing a peak flow meter test.

**EQUIPMENT and SUPPLIES**
- Peak flow meter
- Disposable mouthpiece
- Notebook with pen
- Biohazard waste container
- Patient's record

**PROCEDURAL STEPS**

1. Sanitize your hands.
2. Place the mouthpiece on the peak flow meter and slide the marker to the bottom of the scale.
   **PURPOSE:** The indicator must be at the bottom of the scale for proper measurement of expiratory effort (Figure 1).
3. Introduce yourself and confirm the patient's identity.
4. Explain the purpose of the test.
   **PURPOSE:** To help reassure the patient.
5. Explain the actual maneuver of forced expiration.
   **PURPOSE:** The patient must understand the maneuver so that he or she can cooperate fully; this produces the best test results.
6. Make sure the patient is comfortable and in a proper position, either sitting upright or standing (standing is preferred).
   **PURPOSE:** Proper positioning ensures maximum lung expansion and accurate test results.
7. Loosen any tight clothing, such as a necktie, bra, or belt.
   **PURPOSE:** Tight clothing may restrict breathing capacity.
8. Hold the meter upright, taking care not to block the opening with the fingers (Figure 2).
   **PURPOSE:** To prevent obstruction of forced exhalation.
9. Instruct the patient to inhale as deeply as possible, to place the mouthpiece into the mouth beyond the teeth, and to form a tight seal with the lips. Caution the patient not to put the tongue in the mouthpiece when exhaling.
   **PURPOSE:** To prevent any leakage of air around the mouthpiece and any obstruction of airflow.
10. Instruct the patient to exhale as fast and as forcefully as possible into the peak flow meter.
11. The forced exhalation will move the marker up the scale and stop at the point of the peak expiratory flow. Record this number and return the marker to the bottom of the scale.
12. Repeat the procedure two more times, sliding the indicator to the bottom of the scale before each reading, and record each result.
13. Encourage the patient to inhale as deeply as possible and to exhale as fast and as forcefully as possible with each effort.
14. Place the test results on the patient's chart for the physician to review, noting the time and date of the highest reading.
15. Clean and disinfect the equipment, discarding waste in a biohazard waste container, or give the patient the meter for continued use at home with instructions to follow the manufacturer's cleaning recommendations.
16. Sanitize your hands.
   **PURPOSE:** To ensure infection control.
17. Record the testing information in the patient's chart.
   **PURPOSE:** Procedures that are not recorded are considered not done.
   **CAUTION:** Peak flow readings may trigger bronchospasms or severe coughing in patients experiencing an asthma attack. If this occurs, instruct the patient to rest and try again. If the patient is unable to perform three readings because of bronchospasms and/or coughing, follow the physician's guidelines for managing this situation.
PATIENT EDUCATION FOR A METERED-DOSE INHALER

Instruct the patient in the use of a metered-dose inhaler has follows:
1. Shake the canister vigorously and place it into the mouthpiece device.
2. Open your mouth and hold the inhaler approximately 1 inch away. (If the patient places the mouthpiece in the mouth, the gas propellant causes the drug to bounce off the back of the throat, and much of it will be lost around the mouth.)
3. Exhale normally. Then, while beginning to inhale slowly, depress the canister, releasing a metered dose of medication.
4. Continue to breathe in until your lungs are full; hold the breath to a count of 10, if possible, and then breathe out normally.
5. If a second dose has been prescribed, wait at least 1 minute between puffs.
6. Some inhalers come attached to spacers or can be adapted to meet the needs of children or older patients who have difficulty managing the technique. When the canister is depressed, the medication stays in the spacer, and the patient can take more time to inhale the particles (see Figure 46-8, B).

Pneumoconioses

Environmental causes of respiratory diseases include inhaled dusts, fumes, and various kinds of organic or inorganic matter. Most of these respiratory diseases are occupational; they are the consequence of long-term exposure to unsafe air in the workplace. Although the respiratory system is designed to filter and trap air contaminants, it can become overloaded after intense exposure. Subsequently, irritants enter the lungs, and the amount of damage to pulmonary tissue increases if the particles are very small and can enter the alveoli; if the individual is exposed to a large amount of contaminants over a long period; and when there is the added irritation of cigarette smoking.

Some occupations that can cause pneumoconiosis include coal mining (anthracosis); insulation manufacturing and shipbuilding (asbestosis); and stonecutting or sandblasting (silicosis). The tissue changes caused by inhalation of these substances into the lungs are irreversible. Patients develop dyspnea, cough, and emphysema-like changes and have an increased risk of lung cancer.

Emphysema

Emphysema is a progressive obstructive disease of the pulmonary system that is irreversible. Emphysema causes loss of elasticity in the walls of the alveoli, and eventually these walls stretch and break, creating air spaces that cannot conduct the oxygen–carbon dioxide exchange. The remaining alveoli become overinflated, and as time progresses, exhaling completely becomes very difficult. Cigarette smoking is the primary contributing factor, although patients who develop emphysema at an early age may have a genetic predisposition to the disease. Other contributors include exposure to pollutants (pneumoconioses) or chronic respiratory disorders (chronic bronchitis or asthma).

Symptoms may not be seen until irreversible damage has occurred. When signs and symptoms occur, they include dyspnea, shortness of breath (SOB), wheezing, production of thick mucus, restlessness, fatigue, anorexia, persistent cough (productive or nonproductive), and peripheral cyanosis with clubbing (Figure 46-9). The patient typically is diagnosed from presenting signs and symptoms and a chest x-ray examination, as well as a pulmonary function test (PFT) that shows increased residual volume and decreased forced expiratory volume (Table 46-3).

Patients with emphysema are encouraged to avoid respiratory irritants and individuals with respiratory infections and to stop smoking. Many of these patients require oxygen therapy and benefit from portural drainage and chest percussion to enable the patient to expectorate trapped mucus. Nebulizer treatments also may be prescribed.

Patients with emphysema expend a great deal of energy just to expel air from the lungs, so they should consume a high-caloric, high-fluid diet and perform certain exercises, such as pursed-lip breathing, to help them conserve energy. A patient with emphysema requires continuous care and support; therefore, encouraging family involvement in the treatment plan is important. Referral to a pulmonary rehabilitation program or support group can benefit both patient and family members.

Obstructive Sleep Apnea

Obstructive sleep apnea occurs when the muscles in the posterior pharynx that support the soft palate, uvula, tonsils, and tongue relax during sleep. This relaxation causes the trachea to narrow or close with inhalation, momentarily stopping breathing. Blood oxygen levels are lowered, and the brain senses hypoxemia so it stimulates the patient from sleep to reopen the trachea. The patient is awake so briefly he or she is not aware of the arousal, but this occurs repeatedly throughout the night, preventing the person from achieving a deeper, more restful level of sleep. Because of this interrupted sleep, the individual frequently complains of sleepiness during the day.
PROCEDURE 46-2

Assist the Physician with Patient Care: Administer a Nebulizer Treatment

GOAL: To perform a nebulizer treatment.

EQUIPMENT and SUPPLIES
- Nebulizer machine
- Disposable connector tubing with medication dispenser
- Disposable mouthpiece or mask as ordered
- Medication as ordered and sterile saline or water (diluent) for mixing
- Biohazard waste container
- Patient's record and pen

PROCEDURAL STEPS
1. Plug the nebulizer into a properly grounded electrical outlet.
2. Introduce yourself and confirm the patient's identity.
3. Explain the purpose of the treatment.
   PURPOSE: To help reassure the patient.
4. Sanitize your hands.
5. Measure the prescribed dose of drug and diluent and place the mixture into the nebulizer medication cup (Figure 1).
6. Replace the top of the medication cup and connect it to the mouthpiece or face mask.
7. Connect the disposable tubing to the nebulizer and the medication cup.
8. The patient should be sitting upright to allow for total lung expansion.
   PURPOSE: Proper positioning ensures adequate dispersal of the medication.
9. Turn on the nebulizer (a mist should be visible coming from the back of the tube opposite the mouthpiece or into the face mask).
   PURPOSE: The mist is the aerosolized medication.
10. If using a mask, position it comfortably but securely over the patient's mouth and nose.
11. If using a mouthpiece, instruct the patient to hold it between the teeth with the lips pursed around the mouthpiece (Figure 2).
12. Encourage the patient to take slow, deep breaths through the mouth and to hold each breath 2 to 3 seconds to allow the medication to disperse through the lungs.
   PURPOSE: To ensure maximum distribution of the medication in the lung tissue.
13. Continue the treatment until aerosol is no longer produced (approximately 10 minutes).
   CAUTION: If the patient is receiving a bronchodilator (albuterol), he or she may experience dizziness, tremors, or tachycardia. Continue the treatment unless otherwise ordered by the physician.
14. Turn off the nebulizer.
15. Encourage the patient to take several deep breaths and to cough to loosen secretions into disposable tissues.
16. Dispose of the mouthpiece or mask and tubing in a biohazard container and instruct the patient also to dispose of the contaminated tissues in the biohazard container.
   PURPOSE: To ensure infection control.
17. Sanitize your hands.
   PURPOSE: To ensure infection control.
18. Record the nebulizer treatment; the patient's response, including the amount of coughing and whether coughing was productive or nonproductive; and any side effects of the medication.
   PURPOSE: Procedures that are not recorded are considered not done.
19. If the patient is to continue home nebulizer treatments, provide patient education for both the patient and caregivers as appropriate. Make sure they demonstrate the treatment steps to confirm understanding.
   PURPOSE: Feedback through demonstration of technique ensures patient follow-through.
<table>
<thead>
<tr>
<th>LUNG FUNCTION</th>
<th>DESCRIPTION</th>
<th>PATIENT INSTRUCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal volume (TV)</td>
<td>Volume of air inspired and expired during a normal respiration</td>
<td>Patient breathes in and out normally with lips pursed around mouthpiece.</td>
</tr>
<tr>
<td>Vital capacity (VC)</td>
<td>Maximum amount of air that can be expired after maximum inspiration</td>
<td>Patient takes deep breath and exhales completely (not forcefully).</td>
</tr>
<tr>
<td>Inspiratory capacity (IC)</td>
<td>Maximum amount of air that can be inspired after a normal expiration</td>
<td>Patient breathes in and out normally, then forcibly inhales at the end of the TV.</td>
</tr>
<tr>
<td>Expiratory reserve volume (ERV)</td>
<td>Maximum volume of air that can be exhaled after a normal expiration</td>
<td>Patient breathes in and out normally, then exhales forcibly at the end of the TV.</td>
</tr>
<tr>
<td>Residual volume (RV)</td>
<td>Volume of air left in lungs after forced expiration</td>
<td></td>
</tr>
<tr>
<td>Functional residual volume (FRV)</td>
<td>Amount of air left in the lungs after a normal expiration</td>
<td></td>
</tr>
<tr>
<td>Forced vital capacity (FVC)</td>
<td>Amount of air that can be forcefully exhaled from a maximum inhalation</td>
<td>Patient inhales as deeply as possible, then forcibly exhales as much as possible.</td>
</tr>
<tr>
<td>Maximum volume ventilation (MVV)</td>
<td>Maximum volume the patient can breathe in and out in 1 minute</td>
<td>Patient breathes in and out as deeply and as frequently as possible for 15 seconds (total volume is multiplied by 4).</td>
</tr>
</tbody>
</table>

Individuals are at greater risk of developing obstructive sleep apnea if they are overweight, because a fat or thick neck may narrow the trachea; if they have enlarged adenoids or tonsils; if they are male, because men develop sleep apnea twice as frequently as women; if they have a family history of sleep apnea; and if they drink alcohol or take sedatives, because these chemicals relax throat muscles.

Patients with suspected sleep apnea report chronic fatigue (from the constant startling out of a restful sleep) and pronounced snoring. Sleep apnea is diagnosed after the patient has been monitored during a sleep study, a process called nocturnal polysomnography. The patient is connected to equipment that monitors the pulse rate, brain activity, breathing patterns, blood oxygen levels, and limb movements during sleep.

Multiple complications in addition to chronic daytime fatigue can occur because of sleep apnea. Patients are more susceptible to hypertension and resultant heart disease because hypoxic episodes during sleep raise blood pressure and put a strain on the heart. Individuals with sleep apnea also tend to complain of memory problems, morning headaches, depression, and nocturia.

Sleep apnea typically is treated with a continuous positive airway pressure (CPAP) machine (Figure 46-10), which delivers air pressure through a mask placed over the mouth or through a cannula in the nose. The air pressure created by the machine is greater than that of the surrounding air, and it forces the upper airway passages open and prevents tracheal collapse. Although CPAP is the preferred method of treatment, it can be awkward and uncomfortable, making it difficult to sleep. Patients may have to experiment with different types of masks and need to be encouraged to follow through with the recommended treatment. Individuals with mild obstructive sleep apnea can try alternative treatment with a dental device that opens the throat by bringing the jaw forward. Surgery may also be an option to remove the uvula, tonsils, and adenoids, as well as excess tissue from the nose and back of the throat that vibrates during sleep, resulting in snoring.

### COMMON SIGNS AND SYMPTOMS OF OBSTRUCTIVE SLEEP APNEA

- Excessive daytime sleepiness (hypersomnia)
- Persistently loud, disruptive snoring
- Snoring, choking, or gasping sounds while asleep
- Episodes of breathing cessation during sleep
- Dry mouth or sore throat on awakening
- Morning headache

### CRITICAL THINKING APPLICATION 46-3

Dr. Samuelson has quite a few patients with either asthma or emphysema. Under Dr. Samuelson's direction, Michael is expected to reinforce patient education and answer patients' and family members' questions. Michael decides to make a file on pertinent health education information and review it with Dr. Samuelson before using it to help coordinate the care of these patients. What information should Michael include in the file? What community resources or groups should be included for patient support?

## Pulmonary System Tumors

The most prevalent neoplasms of the respiratory system are lung cancer and carcinoma of the larynx.

### Lung Cancer

Lung cancer is the leading cause of cancer-related deaths for both men and women in the United States. It is estimated that 90% of lung tumors are linked to cigarette smoking; other risk factors include chronic exposure to second-hand smoke, carcinogens
the chest, such as bronchial obstruction, atelectasis, hemoptysis, chest pain, and pleural membrane involvement. Unless the tumor is diagnosed very early, lung cancer has a poor prognosis. Treatment consists of surgery, radiation therapy, and chemotherapy.

**Carcinoma of the Larynx**

Carcinoma of the larynx is pathologically linked to smoking and chronic alcohol consumption. Ninety percent of cases of laryngeal cancer occur in men; most of those affected are 60 to 70 years of age. Patients show early signs of hoarseness, loss of voice, and dysphagia (difficulty swallowing), and occasionally, respiration becomes impaired. Because of these early symptoms, most laryngeal tumors are discovered in the early stages and can be removed, resulting in a very good prognosis. Surgical treatment consists of a partial or total laryngectomy. With a total laryngectomy, the voice is permanently lost, and a tracheostomy is performed. Patients undergoing such procedures need comprehensive preparation and benefit from meeting a laryngectomy survivor, as well as participating in a support group to deal with postsurgical adjustments.

**THE MEDICAL ASSISTANT’S ROLE IN PULMONARY PROCEDURES**

### Assisting with the Examination

Preparing a patient for a respiratory examination includes having the patient disrobe to the waist and put on a gown with the opening in the front or back, depending on the physician’s preference. To assess the status of the respiratory system, the physician uses inspection, palpation, percussion, and auscultation on the anterior thorax, then repeats the process on the posterior and lateral thorax. The medical assistant is responsible for assisting the physician throughout the examination, providing the privacy and support for the patient, and performing diagnostic tests as ordered.

### Diagnostic Procedures

**Tuberculosis**

If the physician orders TB screening, the medical assistant administers the Mantoux test (see Chapter 35). An intradermal
injection of PPD from a live tuberculin bacillus culture is given to test for the presence of tuberculin antibodies. A positive Mantoux reaction indicates the possibility of active or latent TB or exposure to the disease. Further testing by sputum culture and chest x-ray examination is required for a definitive diagnosis.

**Spirometry**

PFTs are performed to diagnose a pulmonary abnormality and/or to determine the extent of a pulmonary disease (see Table 46-3). In physicians’ offices, lung function measurements are taken with a spirometer (Figure 46-13). Successful spirometry requires consistent methods of preparing the patient, explaining and performing the procedure, and determining the results.

Patient preparation begins when the procedure is scheduled. The patient should be instructed not to smoke and to refrain from using bronchodilators and nebulizers for 6 hours before the test.

The medical assistant may be responsible for conducting this test in the ambulatory care setting (Procedure 46-3). Before the patient is scheduled for the procedure, the physician considers certain health problems that would contraindicate the test, such as a pneumothorax, a history of angina or recent myocardial infarction, or the presence of vascular aneurysms. When the patient arrives for testing, the medical assistant should explain the purpose of the test, obtain the patient’s vital signs (including height and weight), and explain the maneuver. Spirometry should be described briefly; in simple terms. One statement that works well is, “I am going to have you blow into a machine to see how much air your lungs hold and how fast you can expel it. The test does not hurt, but it does require your cooperation and lots of effort.” The patient should be in a comfortable upright position with the legs uncrossed and both feet on the floor. Dentures that fit poorly may be a nuisance and should be removed if they might interfere. The chin should be slightly elevated and the neck slightly extended. This position should be maintained throughout the forced expiratory procedure.

Give specific instructions in simple, direct terms; for example, “I want you to take the deepest breath possible, put the mouthpiece in your mouth and seal your lips tightly around it, and then blow into the tube as hard and as fast as you can in one long, complete breath.” An analogy that sometimes is helpful for further explaining the maneuver is, “It’s like blowing out the candles on a birthday cake when they don’t all go out; you need to keep blowing the same breath until they do.”

Next, demonstrate the maneuver. Many patients forget some or all of the instructions they just received, so demonstration reinforces exactly what to do. Show the patient the proper chin and neck position, how to place the mouthpiece at the right time, and how to blow the air out and continue to blow.

When the demonstration is done, remind the patient of the following points:

- Take as deep a breath as possible.
- Blow air out hard.
- Do not stop blowing until you are told to stop.

Use active and forceful coaching while the patient is performing the maneuver. You may need to raise your voice with some urgency to improve the patient’s performance, using such phrases as, “Blow, blow, blow!” “Keep blowing, keep blowing!” and “Don’t stop blowing!” After the maneuver, give the patient some feedback on the quality of the test and describe what improvements could be made. Continue to repeat efforts until the patient has completed three acceptable maneuvers. The two best efforts are used to calculate pulmonary function. The physician calculates normal values for each patient based on the individual’s age, height, weight, and gender; the test results are documented as a percentage. If the patient’s best efforts are greater than 80% of pretest calculated values, pulmonary function is considered normal. Spirometry tests provide the physician information about the impact of obstruction or pulmonary disease on airflow. If the results are less than 60% of the predicted value, the patient may be given bronchodilators and be retested to determine the impact of the inhalant on function.

**Test Results.** Place the results of the maneuvers with the patient’s chart on the physician’s desk when the tests are completed. Many physicians rely on the assistant to include comments pertinent to the testing, such as the patient’s condition during the test and compliance with coaching. If any questions arise about the quality of the results, ask the patient to wait while the physician reviews the results. If the patient has delayed taking medication, check with the physician as to when the patient should resume taking it.

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**CRITICAL THINKING APPLICATION 46-4**

Michael is teaching Cindy, a new employee, how to perform a spirometry test. He has summarized the steps of the procedure on a card, which is kept next to the machine for easy reference. Cindy knows nothing about the procedure. What would be the best way for Michael to teach her about the test? What information should he include?

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**Pulse Oximetry**

Pulse oximetry is a noninvasive method of evaluating both the pulse rate and the oxygen saturation of hemoglobin in arterial blood. It identifies the percentage of hemoglobin that is oxygenated in comparison with the total amount of hemoglobin available. Many ambulatory settings use pulse oximeters to assess a
PROCEDURE 46-3

Assist the Physician with Patient Care: Perform Volume Capacity Spirometry Testing

GOAL: To perform volume capacity testing.

EQUIPMENT and SUPPLIES
- Scale with height measuring device
- Sphygmomanometer and stethoscope
- Spirometer with recording paper in place
- External spirometric tubing
- Disposable mouthpiece
- Nasal clip if needed
- Biohazard waste container
- Patient's record

PROCEDURAL STEPS

1. Sanitize your hands and assemble the spirometer.
2. Introduce yourself and confirm the patient's identity. Determine whether the patient needed any special preparation and if so, whether it was done.
   PURPOSE: If special procedures were not followed, the test may have to be rescheduled.
3. Explain the purpose of the test.
   PURPOSE: To help reassure the patient.
4. Measure and record the patient's vital signs, height, and weight.
5. Explain the actual maneuver.
   PURPOSE: The patient must understand the maneuver so that he or she can cooperate fully; this produces the best test results.
6. Make sure the patient is comfortable and either is standing or is sitting with the legs uncrossed and the feet on the floor.
   PURPOSE: Proper positioning ensures maximum lung expansion and accurate test results.
7. Loosen any tight clothing, such as a necktie, bra, or belt.
   PURPOSE: Tight clothing may restrict breathing capacity.
8. Show the patient the proper chin and neck position: the chin should be slightly elevated and the neck slightly extended.
9. Practice the maneuver with the patient before beginning the test.
   PURPOSE: To relieve apprehension and enhance understanding.
10. Place a soft nose clip on the patient's nose if this is part of the facility's procedure.
    PURPOSE: To prevent air from escaping through the nose during exhalation.
11. Instruct the patient to place the mouthpiece in the mouth and to seal the lips around it (Figure 1).
12. Tell the patient to inhale according to instructions.
13. Use active, forceful coaching during exhalation.
    PURPOSE: Coaching improves performance.
14. Provide the patient with feedback after he or she completes the maneuver.
    PURPOSE: Encouragement and explanations of mistakes in the maneuver can help improve the patient's compliance.
15. Carefully observe the patient for indications of vertigo or dyspnea or any other signs of difficulty. If complications occur, stop the test and inform the physician.
16. Continue testing until three acceptable maneuvers have been performed.
17. Place the test results on the patient's chart for the physician to review.
18. Clean and disinfect the equipment. Discard waste in a biohazard waste container.
19. Sanitize your hands.
    PURPOSE: To ensure infection control.
20. Record the testing information in the patient's medical record.
    PURPOSE: Procedures that are not recorded are considered not done.

Figure 1

patient's oxygenation status in such disorders as pneumonia, bronchitis, emphysema, or asthma (Figure 46-14, A).

To perform the procedure, the medical assistant clips a probe on the patient's carotid or finger (Figure 46-14, B). Fingernail polish must be removed before the clip is applied. A beam of infrared light passes through the tissue, and the machine measures the amount of light absorbed by oxygenated hemoglobin, which is displayed on the digital screen as a percentage. At the same time the light measures the patient's pulse rate, which is shown on the screen. A normal pulse oximetry reading is 95% or higher (meaning 95% of the total available hemoglobin attachments for oxygen are carrying oxygen). Treatment, such as oxygen or bronchodilator therapies, usually is started when readings are 90% to 92% or lower.

Obtaining Sputum for Culture

A sputum culture is requested when signs and symptoms are accompanied by physical evidence of pneumonia, TB, or other
infectious diseases of the lower respiratory tract. The specimen is sent to a laboratory equipped to handle potentially infectious bacteriologic samples. The sample is cultured and incubated, and the pathogenic organism grown in the culture medium is identified. If possible, the physician refrains from starting antibiotic therapy until the sputum has been collected. The sample may also be sent to the laboratory for cytologic analysis, which may indicate a cancerous condition of the lungs or bronchi.

Methods of Collection. In the ambulatory care setting, the primary method of collecting a sputum sample is expectoration (Procedure 46-4). However, sputum also can be collected by tracheal suctioning and bronchoscopy. If the sample is to be collected by expectoration, most physicians have the patient perform the procedure at home with instruction. The medical assistant may be responsible for explaining the procedure to the patient or reinforcing the physician’s instructions. The patient should understand that the best time for collecting a sputum specimen is in the morning when the patient first wakes up, before eating or drinking. The patient can rinse out the mouth with water before collecting the sample to reduce contamination from the oropharynx. The sample is collected from sputum coughed up from the lungs, not from saliva, so the patient should be encouraged to cough deeply and forcefully to collect a satisfactory sample. It may help to have the patient take several deep breaths and then cough. At least 1 teaspoon of sputum should be collected in a sterile specimen cup (the patient needs to know how to handle the specimen cup to maintain sterility), which must be returned to the office or laboratory as soon as possible after collection.

If the patient is taking antibiotic medications at the time of the specimen collection, this information should be included on the laboratory slip. If the cough does not produce sputum, chest physiotherapy or nebulization may be ordered by the physician to induce it. In some cases the physician may order sputum collection for three consecutive mornings.

CRITICAL THINKING APPLICATION 46-5
Tomas Garcia, a 68-year-old patient, has a chronic cough, and Dr. Samuelson orders a sputum culture to rule out an infectious disease. Mr. Garcia is supposed to collect the specimens every morning for the next 3 days, but he is very hard of hearing and does not understand English very well. His daughter, who is bilingual, is with him at today’s visit. How should Michael relay the information about how to collect the sputum sample? What important details should be reviewed with Mr. Garcia’s daughter?

Bronchoscopy
Bronchoscopy typically is performed in an outpatient clinic or a hospital. However, the medical assistant should be familiar with the procedure, because he or she probably will schedule the test, instruct the patient on preparation, and help answer questions from the patient or family.

Bronchoscopy provides an endoscopic view of the larynx, trachea, and bronchi. A pulmonary specialist or a surgeon performs the procedure, using a flexible fiberoptic instrument through which the physician can visualize respiratory tissues and collect biopsy specimens or bronchial washings as needed for cytologic evaluation or culture. Laser therapy to treat endotracheal lesions also is possible through the flexible scope.

The patient should remain on nothing by mouth (NPO) status for 4 to 8 hours before the test to reduce the risk of aspiration. The patient should perform good mouth care before the
PROCEDURE 46-4

Obtain Specimens for Microbiologic Testing: Obtain a Sputum Sample for Culture

**GOAL:** To collect a sputum sample while following Standard Precautions.

**EQUIPMENT and SUPPLIES**
- Sterile laboratory specimen cup, accurately labeled
- Biohazard laboratory specimen bag with laboratory requisition
- Disposable examination gloves
- Face shield with goggles
- Impervious gown
- Biohazard waste container
- Cup of water
- Ginger ale or juice
- Patient’s record

**PROCEDURAL STEPS**

1. Assemble the equipment and label the specimen cup.
2. Identify the patient and explain the procedure.
   **PURPOSE:** The informed patient is more cooperative.
3. Sanitize your hands and put on gloves, a face shield with goggles, and an impervious gown.
   **PURPOSE:** Standard Precautions must be followed when potentially infectious materials are collected.
4. Have the patient rinse his or her mouth with water.
   **PURPOSE:** Any food particles in the mouth will contaminate the specimen.
5. Carefully remove the specimen cup lid, taking care not to touch the inside of the lid or the inside of the container, and place it upside down on a side table.
   **PURPOSE:** To maintain the sterile environment of the specimen cup.
6. Instruct the patient to take three deep breaths and then cough deeply to bring up secretions from the lower respiratory tract.
   **PURPOSE:** The organisms for culture must be from the lung fields in the lower respiratory tract.
7. Tell the patient to spit directly into the specimen container and to avoid getting any sputum on the exterior of the container. Do not touch the inside of the container during the procedure.
   **PURPOSE:** Sputum on the exterior of the container is considered hazardous. Prevent contamination of the inside of the container.
8. Place the lid securely on the container, taking care not to touch the inside of the lid, and then place the container in the plastic specimen bag.
   **PURPOSE:** To maintain the sterility of the container and to minimize the chance of spreading the potentially infectious organisms.
9. Offer the patient a glass of juice or ginger ale.
   **PURPOSE:** The patient may have a bad taste in the mouth after the test, and this may cause nausea.
10. If another sputum test is ordered for the next morning, instruct the patient when to come to the office or explain how to perform the procedure at home. Remind the person to follow the same instructions for preparation. Stress the importance of maintaining the sterility of the container and of collecting the specimen first thing in the morning.
11. Clean the work area and properly dispose of all supplies.
    **PURPOSE:** To follow Standard Precautions.
12. Sanitize your hands.
    **PURPOSE:** To ensure infection control.
13. Process the specimen immediately to ensure optimum test results or refrigerate the specimen until it is sent to the laboratory for analysis.
    **PURPOSE:** Microorganisms may propagate or die, which can result in a false-positive or false-negative result.
14. Record the procedure in the patient’s record.
    **PURPOSE:** Procedures that are not recorded are considered not done.

The procedure to reduce the number of bacteria present. Dentures should be removed. The patient receives medication before the procedure to aid relaxation and to dry up oral secretions. The patient should be reassured that the procedure does not interfere with breathing.

Before the instrument is inserted, the physician sprays a topical anesthetic (lidocaine) into the mouth and on the back of the throat to help suppress the gag reflex and reduce any discomfort from passage of the instrument. The tube can be inserted through the nose or mouth, and as it reaches the glottis, more lidocaine is sprayed to control the cough reflex. The physician continues to pass the tube through the bronchi and larger bronchioles, collecting biopsy specimens of any suspicious tissue and obtaining cellular washings if indicated. Because the patient is sedated, it is not an uncomfortable procedure, but the patient may complain of a sore throat and may experience hemoptysis for several hours after the procedure. Biopsy and culture reports usually are available in 2 to 7 days.

**CLOSING COMMENTS**

**Patient Education**

It is often said that the greatest fear a person has is the fear of the unknown. Patients frequently worry about tests the physician has ordered. The imagination can create all types of frightening scenarios with even more alarming outcomes. The medical assistant plays a vital role in allaying patients’ fears by explaining diagnostic tests, making sure the patient understands how to prepare for the examination and what will be expected of him or her during the procedure. Make sure to give the patient brochures or handouts explaining the procedure that he or she can review
at home. Answer all the patient’s questions, and consult the physician about questions or concerns you cannot address before the patient leaves the office.

Legal and Ethical Issues

When the respiratory system is mentioned, people generally think of breathing; however, this is only one of the activities of the respiratory system. The cells of the body need a continuous supply of oxygen to maintain life. The respiratory system works with the circulatory system to supply this oxygen and to remove the waste products of metabolism. Too often people take breathing for granted and assume that nothing could possibly happen to their ability to breathe. Sadly, respiratory diseases are the leading cause of death, and that means that people we know and love will suffer from and die of some of the diseases discussed in this chapter.

If the pulmonary test ordered is an invasive test, such as bronchoscopy, make sure a written consent form is obtained from the patient and is in the patient’s chart. If the patient is to see another specialist, a consent form must be signed giving permission to copy and forward patient information to the consultant. If oxygen therapy is ordered, the physician must write a prescription that specifies the amount of oxygen to be given and the type of device to be used for delivery. The physician also may write an order for a respiratory care practitioner to follow up on the patient at home.

SUMMARY OF SCENARIO

Michael has become very adept at performing respiratory diagnostic procedures and treatments for ambulatory patients. He enjoys interacting with this special group of patients and works at maintaining an up-to-date file on educational and resource assistance in the community. Michael especially enjoys the patient education aspect of caring for people with respiratory diseases. Many of these patients have chronic diseases that require long-term care by a physician, and Michael attempts to use available “teaching moments” to reinforce healthy lifestyle habits and confirm patients’ understanding of the treatments.

He also continues to take advantage of local meetings of the American Association of Medical Assistants (AAMA) to keep up with recent practice trends, and he took a medical terminology refresher course at the local community college to improve his patient interviewing and charting skills. He is investigating starting a Smoke Stoppers group out of Dr. Samuelson’s office to encourage patients to develop healthier lifestyles, and he emphasizes to his patients who work in the area’s coal mines and construction businesses the importance of consistently wearing respirators.

SUMMARY OF LEARNING OBJECTIVES

1. Define, spell, and pronounce the terms listed in the vocabulary.
   Spelling and pronouncing medical terms correctly bolster the medical assistant’s credibility. Knowing the definitions of these terms promotes confidence in communication with patients and co-workers.

2. Apply critical thinking skills in performing the patient assessment and patient care.
   Completing the Critical Thinking Application exercises throughout the chapter can help the student medical assistant become more adept at critical analysis of real-life situations.

3. Describe the organs of the respiratory system and their functions.
   The respiratory system exchanges oxygen for carbon dioxide waste through external and internal respiration and helps maintain acid-base balance in the body. It works with the circulatory system to supply body cells with oxygen and remove metabolic wastes. The upper respiratory tract transports air through the nose, pharynx, and larynx. The lower respiratory tract consists of the trachea, bronchial tubes, and lungs.

4. Explain the process of ventilation.
   Ventilation is the process by which the bronchioles deposit oxygenated air into the alveoli. A network of pulmonary capillaries surround the alveoli, and oxygenated air moves out of the single-celled walls of the alveoli and into the capillaries. Carbon dioxide is forced out of the capillaries, into the alveoli, and then out through the bronchioles. Inspiration is the movement of oxygen from the atmosphere into the alveoli; expiration is the movement of carbon dioxide from the alveoli into the atmosphere.

5. Use correct respiratory system terminology when documenting procedures.
   Table 46-1 defines common terms related to the respiratory system that should be used when charting a patient’s signs and symptoms.

6. Compare and contrast infections and inflammations of the respiratory system.
   URI include the common cold, which is caused by a virus; sinusitis, which may be a result of an infection or allergic reaction; allergic rhinitis, which is triggered by multiple factors and causes nasal symptoms; and pneumonia, an infection of the lungs that can be caused by multiple pathogens and that may range from a minor infection to a life-threatening disease.

7. Describe the diagnosis and treatment of tuberculosis.
   TB, caused by M. tuberculosis, can be either active or latent. Individuals with active TB are infectious and show the symptoms of the disease; those with latent TB have activated tubercles because of a weakened immune system. TB is diagnosed by a combination of PPD testing, chest x-ray studies, blood tests, and sputum cultures. It is treated with multiple medications, depending on the type and stage of the disease.

8. Summarize the disorders associated with chronic obstructive pulmonary disease and their treatments.
   COPD is a group of diseases with the common characteristic of chronic airway obstruction. They include chronic bronchitis, bronchiectasis, asthma, pneumonia, emphysema, and sleep apnea. The mechanism
of obstruction may vary, but all these patients are unable to ventilate the lungs freely, which results in ineffective exchange of respiratory gases. Treatments include bronchodilator and corticosteroid inhalers, evaluation of peak flow values, nebulizer treatments, oxygen, chest therapy, and CPAP machines.

9. Teach a patient how to use a peak flow meter.
   Procedure 46-1 outlines the procedure for teaching a patient how to obtain an accurate peak flow reading.

    Procedure 46-2 outlines the procedure for administering a nebulizer treatment.

11. Detail patient teaching for the use of a metered-dose inhaler.
    The patient first shakes the container and then places it in the dispenser. The person opens the mouth, and holding the dispenser about 1 inch away, pushes the container down while inhaling deeply. The breath is held for a count of 10, and then the person slowly exhales. If a second dose is required, the patient should wait at least 1 minute before administering it. The patient can use a spacer, if needed, to administer the dose.

12. Describe the cancers associated with the respiratory system.
    Lung cancer is the leading cause of cancer-related deaths for both men and women; the lung also is a common site of metastatic tumors. The prognosis is very poor for lung cancer, because early symptoms mimic chronic conditions present in long-term smokers. Carcinoma of the larynx is linked to smoking and chronic alcohol consumption. Most laryngeal tumors are discovered in the early stages and are associated with a good prognosis.

13. Distinguish among common diagnostic procedures for the respiratory system.
    Respiratory diagnostic procedures include the Mantoux intradermal test for TB; PFTs, in which a spirometer is used to diagnose pulmonary abnormalities; pulse oximetry, a noninvasive method of evaluating both the pulse rate and the oxygen saturation of hemoglobin in the arterial blood; culturing of expectorated sputum; and bronchoscopy, in which a flexible fiber optic instrument is used to view the larynx, trachea, and bronchi endoscopically.

    Procedure 46-3 summarizes the steps in spirometry testing.

15. Correctly use a pulse oximeter.
    The oximeter probe is placed on the patient's earlobe or finger. An infrared light passes through the tissue, and the machine measures the amount of light absorbed by oxygenated hemoglobin, which is displayed on the digital screen as a percentage. The patient's pulse rate also is displayed.

16. Collect a sputum sample for culture.
    Procedure 46-4 explains how to collect a sputum sample for culture.

**CONNECTIONS**

📖 **Study Guide Connection:** Go to the Chapter 46 Study Guide. Read and complete the activities.

🖥️ **Evolve Connection:** Go to the Chapter 46 link at evolve.elsevier.com to complete the Chapter Review and Chapter Quiz. Puruse other resources listed for this chapter to increase your knowledge of Assisting in Pulmonary Medicine.