CHAPTER 38 Nursing Care of Clients with Ventilation Disorders

LEARNING OUTCOMES

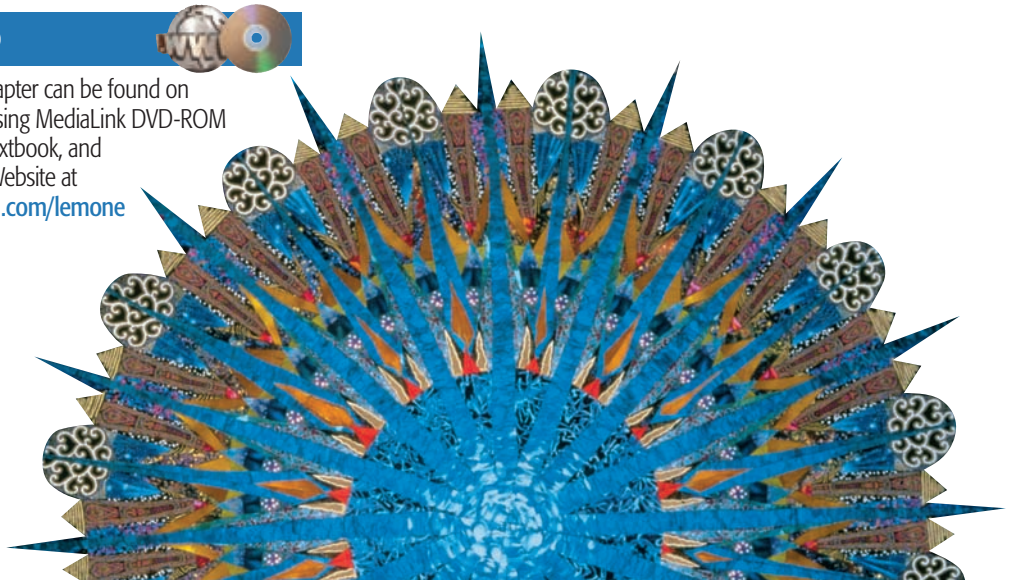
- Relate the pathophysiology and manifestations of lower respiratory infections and inflammation, lung cancer, chest wall disorders, and trauma to the ability to maintain effective ventilation and respiration (gas exchange).
- Compare and contrast the etiology, risk factors, and vulnerable populations for lower respiratory infections, lung cancer, chest wall disorders, and trauma.
- Describe interdisciplinary care and the nursing role in health promotion and caring for clients with lower respiratory infections, lung cancer, chest wall disorders, and trauma.
- Discuss surgery and other invasive procedures used to treat lung cancer, chest wall disorders, and trauma, and nursing responsibilities in caring for clients undergoing these procedures.
- Describe the nursing implications for oxygen therapy and medications used to treat respiratory disorders.

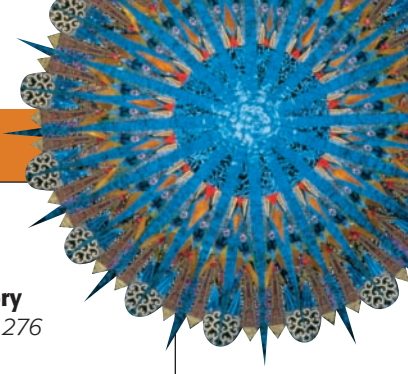
CLINICAL COMPETENCIES

- Assess functional health status and the effects of lower respiratory and chest wall disorders on ventilation and gas exchange.
- Use assessed data and knowledge of the effects of the disorder and prescribed treatment to identify priority nursing diagnoses and plan care for clients with lower respiratory disorders.
- Use the nursing process and evidence-based nursing research to plan and implement individualized nursing care, including measures to promote ventilation and gas exchange, for clients with lower respiratory disorders.
- Plan and provide appropriate teaching for health promotion among vulnerable populations and to prepare clients and families for community-based care.
- Evaluate the effectiveness of nursing interventions and teaching, revising strategies and teaching plans as needed.
- Safely and knowledgeably coordinate interdisciplinary care and administer prescribed medications and treatments for clients with lower respiratory disorders.

MEDIALINK

Resources for this chapter can be found on the Prentice Hall Nursing MediaLink DVD-ROM accompanying this textbook, and on the Companion Website at http://www.prenhall.com/lemone





KEY TERMS

asphyxiation, *1305*
bronchitis, *1266*
cyanosis, *1266*
dyspnea, *1266*
empyema, *1269*
flail chest, *1303*
hemoptysis, *1266*
hemothorax, *1302*
hypoxemia, *1275*
lung abscess, *1280*
pleural effusion, *1295*
pleuritis, *1295*
pneumonia, *1267*
pneumothorax, *1297*
severe acute respiratory syndrome (SARS), *1276*
thoracentesis, *1296*
tuberculosis (TB), *1280*

Disorders affecting the lower respiratory system (below the larynx), pleural cavity, and chest wall can affect the ability to effectively move air into and out of the lungs (ventilation) and the exchange of oxygen and carbon dioxide across the alveolar-capillary membrane (respiration). The disorders discussed in this chapter—respiratory infections and inflammation, trauma and disorders of the chest wall or pleural cavity, and neoplasms of the lung—all affect the ability to maintain clear and patent airways and ventilate the lungs. While these disorders can also affect gas exchange, nursing care for clients with these disorders generally focuses on maintaining airway patency and an effective breathing pattern. Disorders that primarily affect gas exchange are discussed in Chapter 39 ∞.

The lower respiratory and chest wall disorders discussed in this chapter and Chapter 39 have both local and systemic effects. Local effects include cough, excess mucous production, shortness of breath or **dyspnea** (difficult or labored breathing), **hemoptysis** (bloody sputum), and chest pain. Systemic effects may include fever, anorexia and malaise, **cyanosis** (gray to blue or purple skin color caused by deoxygenated hemoglobin), and other manifestations of impaired gas exchange. Before continuing, review the anatomy, physiology, and assessment of the lower respiratory system in Chapter 36 ∞.

INFECTIONS AND INFLAMMATORY DISORDERS

Infections and inflammation of the lower respiratory system are common. The respiratory tree is constantly exposed to the environment as air moves into and out of the lower respiratory tract. In addition, the oropharynx is colonized by huge numbers of microorganisms that may be aspirated into the bronchial tree. Both anatomic and physiologic defenses help maintain the sterility of the lower respiratory tract. When these defenses are impaired, the risk for infection increases. For example, drugs, alcohol, or neuromuscular disease may suppress the cough reflex, and the influenza virus can leave the respiratory epithelium vulnerable to bacterial infection. Even in healthy people, microorganisms and other foreign material occasionally enter the bronchial tree and lung parenchyma.

THE CLIENT WITH ACUTE BRONCHITIS

Bronchitis, inflammation of the bronchi, may be either an acute or a chronic condition. Acute bronchitis is relatively common in adults. Impaired immune defenses and cigarette smoking increase the risk for acute bronchitis. In otherwise healthy adults, it typically follows a viral upper respiratory infection (URI). Chronic bronchitis is a component of chronic obstructive pulmonary disease (COPD) and is discussed in Chapter 39 ∞.

Pathophysiology and Manifestations

Infectious bronchitis can be caused by either viruses or bacteria that damage the respiratory mucosa. In healthy adults, bacterial bronchitis generally only occurs as a complication of viral infection. Inhalation of toxic gases or chemicals can lead to inflammatory bronchitis.

The inflammatory response to infection or tissue damage from inhaled substances causes capillary dilation and edema of the mucosal lining of the bronchi. Inflammatory cells infiltrate the affected mucosa, leading to exudate formation and increased mucous production. Ciliated epithelium is damaged by the inflammatory response and ciliary function is impaired. The immune response of lymphocytes and tissue macrophages is inhibited by some viruses and mycobacteria, increasing the risk for bacterial infection. Mucosal irritation and increased mucous production initiate the cough reflex. The respiratory tract may become hyperirritable for an extended period of time, leading to paroxysms of coughing and bronchospasm (Copstead & Banasik, 2005).

Acute bronchitis is typically heralded by a nonproductive cough that later becomes productive. The cough often occurs in paroxysms, and may be aggravated by cold, dry, or dusty air. Chest pain, often substernal, is common. Other manifestations include moderate fever and general malaise.

INTERDISCIPLINARY CARE

The diagnosis of acute bronchitis typically is based on the history and clinical presentation. A chest x-ray may be ordered to rule out pneumonia, because the presenting manifestations can be similar. Other diagnostic testing is rarely indicated. Treatment is symptomatic and includes rest, increased fluid intake, and the use of aspirin or acetaminophen to relieve fever and malaise. Many physicians prescribe a broad-spectrum antibiotic such as erythromycin or penicillin, because approximately 50% of acute bronchitis is bacterial in origin. An expectorant

cough medication is recommended for use during the day and a cough suppressant at night to facilitate rest.

NURSING CARE

Nursing interventions for clients with acute bronchitis are primarily educational. Include the following teaching topics:

- Increase fluid intake to keep mucus thin and meet increased needs related to fever.
- Use over-the-counter (OTC) analgesics and cough preparations containing dextromethorphan for symptom relief.
- Describe use and effects of any prescribed medications.
- Stress the importance of smoking cessation (as appropriate).

THE CLIENT WITH PNEUMONIA

Inflammation of the lung parenchyma (the respiratory bronchioles and alveoli) is known as **pneumonia**. Despite significant advances in antibiotic therapy, pneumonia remains the seventh leading cause of death in the United States, and the leading cause of death from infectious disease (Porth, 2005). In 2003, more than 65,000 deaths in the United States were attributed to pneumonia and influenza (Hoyert et al., 2006). Its incidence and mortality are highest in older adults and people with debilitating diseases. Pneumonia currently accounts for about 10% of adult hospital admissions in the United States.

FAST FACTS

- The age-adjusted death rate for influenza and pneumonia per 100,000 population declined from 53.7 in 1960 to 22.4 in 2003.
- Overall, men have a higher death rate (27.0 per 100,000) attributed to influenza and pneumonia than women (19.9 per 100,000).
- The differences in death rates attributed to influenza and pneumonia among different races and ethnicity are relatively small; Asian/Pacific Islanders have the lowest rate at 17.5 per 100,000, and African Americans have the highest rate at 24 per 100,000 (National Center for Health Statistics, 2005).

Pneumonia may be either infectious or noninfectious. Bacteria, viruses, fungi, protozoa, and other microbes can lead to infectious pneumonia. Noninfectious causes include aspiration of gastric contents and inhalation of toxic or irritating gases. Pneumonias often are classified as community acquired, nosocomial (hospital acquired), or opportunistic. Different organisms are implicated in each of these classifications (Table 38–1). The most common causative organism for community-acquired pneumonia is *Streptococcus pneumoniae* (also called pneumococcus), a gram-positive bacterium. This organism causes about 50% of cases of community-acquired pneumonia leading to hospital admission. *Mycoplasma pneumoniae, Chlamydia pneumoniae, Haemophilus influenzae*, and the influenza virus are also leading causes of community-acquired pneumonia (Kasper et al., 2005). *Staphylococcus aureus* and gram-negative bacteria such as *Klebsiella pneumoniae, Pseudomonas aeruginosa*, and enteric bacilli, including *Escherichia coli*, are often implicated as nosocomial causes of pneumonia. Organisms such as *Pneumocystis* generally cause infections only in immunocompromised people (opportunistic infections).

Physiology Review

The lower respiratory tract normally is sterile. A number of defense mechanisms help maintain this sterile environment. Infectious particles trapped by the mucous membranes of the nose are removed by sneezing, while those deposited in the nasopharynx usually are swallowed or expectorated. Reflex closure of the epiglottis and the branching bronchial tree present anatomic barriers to entry of microorganisms and other possible contaminants. The cilia and mucus that line the respiratory tract and the cough reflex serve to trap and eliminate foreign matter that enters the lower respiratory tract. Organisms that make it past these barriers usually are rapidly phagocytized in the alveolus by resident macrophages, then attacked by the inflammatory and immune defenses of the body. Aging impairs these immune responses, increasing the risk for pneumonia (see the box on page 1268).

Pathophysiology

The most common means of entry of pathogens into the lung is aspiration of oropharyngeal secretions containing microbes. Microorganisms also may be inhaled after having been released when an infected person coughs, sneezes, or talks. Contaminated aerosolized water also may be inhaled, an important means of spread for viral and some other types of pneumonia. Finally, bacteria may spread to the lungs through the bloodstream from infection elsewhere in the body. Host defenses must be overwhelmed either by the number of organisms or their *virulence* (disease-causing ability) in order for an infection to develop.

TABLE 38–1 **Common Organisms Causing Pneumonia in Adults**

COMMUNITY ACQUIRED	HOSPITAL ACQUIRED	OPPORTUNISTIC
Streptococcus pneumoniae	*Staphylococcus aureus*	*Pneumocystis carinii*
Mycoplasma pneumoniae	*Pseudomonas aeruginosa*	*Mycobacterium tuberculosis*
Haemophilus influenzae	*Klebsiella pneumoniae*	Cytomegalovirus (CMV)
Influenza virus	*Escherichia coli*	Atypical mycobacteria
Chlamydia pneumoniae		Fungi
Legionella pneumophila		

NURSING CARE OF THE OLDER ADULT
Pneumonia

Several changes associated with aging and disease affect respiratory function and airway clearance. The number of cilia decreases, and the cough weakens. Gag and cough reflexes diminish. The older adult is at greater risk for dehydration, leading to thick, viscous mucus that is difficult to expectorate. Immune function declines with aging. These factors increase the risk of pulmonary infection and reduce the older adult's ability to respond effectively to infectious processes.

Other factors also may increase the risk for and severity of lower respiratory infections in the older adult: immobility, smoking history, surgical procedures, use of multiple medications, malnutrition, and such diseases as COPD and heart disease.

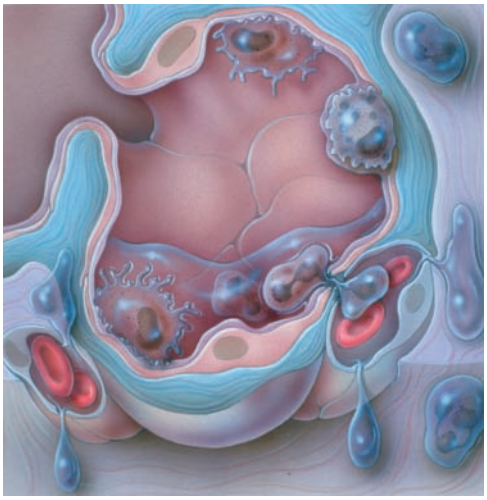


Figure 38–1 ■ In pneumonia, the inflammatory response causes fluid to accumulate in the alveoli and edema to form as alveolar capillaries dilate and allow fluid to leak into interstitial tissues.
Source: Kevin A. Somerville, Phototake NYC.

When the invading microorganisms colonize the alveoli, an inflammatory and immune response is initiated. The antigen–antibody response and endotoxins released by some organisms damage bronchial and alveolar mucous membranes, causing inflammation with vascular congestion and edema. Infectious debris and exudate can fill alveoli, interfering with ventilation and gas exchange (Figure 38–1 ■). Pneumonia may develop in four distinct patterns: lobar pneumonia, bronchopneumonia, interstitial pneumonia, and miliary pneumonia (Table 38–2).

The pathologic process, anatomic location, and manifestations of pneumonias vary according to the infective organism.

Acute Bacterial Pneumonia

Of the bacterial pneumonias, the pathogenesis of pneumococcal (*Streptococcus pneumoniae*) pneumonia is best understood (Figure 38–2 ■). These bacteria reside in the upper respiratory tract of up to 70% of adults. They may be spread by direct person-to-person contact via droplets. In many cases, infection results from aspiration of resident bacteria. In the lower respiratory tract, the inflammatory response initiated by these organisms causes alveolar edema and the formation of exudate. As alveoli and respiratory bronchioles fill with serous exudate, blood cells, fibrin, and bacteria, *consolidation* (solidification) of lung tissue occurs. The lower lobes of the lungs are usually affected because of gravity. Consolidation of a large portion of an entire lung lobe is known as *lobar pneumonia.* This is the typical pattern for pneumococcal pneumonia. *Bronchopneumonia* is patchy consolidation involving several lobules. Other bacterial pneumonias often present with the patchy involvement of bronchopneumonia; pneumococcal pneumonia may also follow this pattern. The process resolves when macrophages predominate, digesting and removing inflammatory exudate from the infected lung.

TABLE 38–2 **Patterns of Lung Involvement in Pneumonia**

PATTERN OF INVOLVEMENT	DESCRIPTION
Lobar pneumonia	Typically involves an entire lobe of a lung. Early in the process, when the immune response is minimal, bacteria spread throughout the affected lobe by rapid accumulation of fluid exudate. As the immune and inflammatory responses develop, RBCs and neutrophils, damaged epithelial cells, and fibrin accumulate in the alveoli. Purulent exudate containing neutrophils and macrophages forms. As alveoli and respiratory bronchioles fill with exudate, blood cells, fibrin, and bacteria, *consolidation* (solidification) of lung tissue occurs. Finally, the process resolves as enzymes destroy the exudate and residual debris is reabsorbed, phagocytized, or coughed out.
Bronchopneumonia	Usually involves dependent portions of lung tissue, characterized by patchy consolidation. Exudate tends to remain primarily in the bronchi and bronchioles, with less edema and congestion of the alveoli than in lobar pneumonia.
Interstitial pneumonia	The inflammatory process primarily involves the interstitium: the alveolar walls and connective tissue supporting the bronchial tree. Involvement may be patchy or diffuse as lymphocytes, macrophages, and plasma cells infiltrate the alveolar septa. While alveoli typically do not contain significant exudates, protein-rich hyaline membranes may line the alveoli, interfering with gas exchange.
Miliary pneumonia	In miliary pneumonia, numerous discrete inflammatory lesions develop as a result of spread of the pathogen to the lungs via the bloodstream. Miliary pneumonia is primarily seen in people who are severely immunocompromised. As a result, the immune response is poor and damage to pleural tissue may be significant.

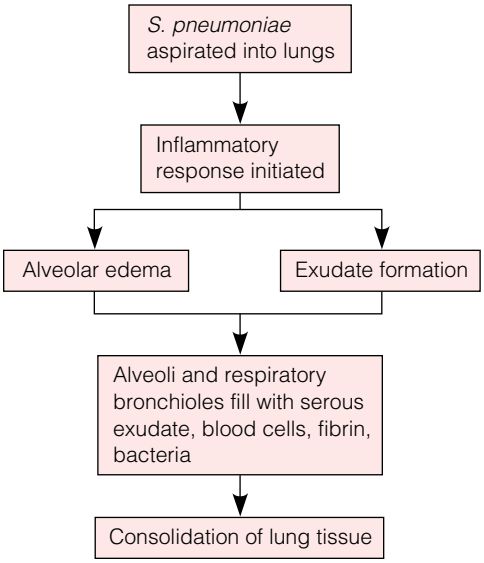


Figure 38–2 ■ The pathogenesis of pneumococcal pneumonia.

MANIFESTATIONS The presentation of bacterial pneumonia is usually acute, with rapid onset of shaking chills, fever, and cough productive of rust-colored or purulent sputum. Chest aching or *pleuritic pain* (sharp localized chest pain that increases with breathing and coughing) is common. Limited breath sounds and fine crackles or rales are heard over the affected area of lung. A pleural friction rub may be audible. If the involved area is large and gas exchange is impaired, dyspnea and cyanosis may be noted.

A more insidious onset with low-grade fever, cough, and scattered crackles is more typical of bronchopneumonia. Dyspnea is less commonly seen. The older adult or debilitated client may have atypical manifestations of pneumonia, with little cough, scant sputum, and minimal evidence of respiratory distress. Fever, tachypnea, and altered mentation or agitation may be the primary presenting symptoms.

COMPLICATIONS Pneumococcal pneumonia typically resolves uneventfully; normal lung structure is restored on completion of the process. Local extension of the infection to involve the pleura (*pleuritis*) is the most common complication. Pneumonias caused by *Staphylococcus aureus* and gram-negative bacteria often cause extensive parenchymal damage with necrosis, lung abscess, and empyema or pleural effusion. Progressive destruction of lung tissue and functional impairment is a possible consequence of *Klebsiella* pneumonia.

A *lung abscess* is a local area of necrosis and pus formation within the lung itself. They are relatively uncommon. The manifestations of lung abscess develop slowly, and include weight loss, malaise, night sweats, fever, and a productive cough. Sputum is foul smelling and tasting. Rupture of the abscess into a larger airway is heralded by production of copious amounts of purulent sputum.

Empyema is accumulation of purulent exudate in the pleural cavity. It is identified by chest x-ray or CT scan. Thoracentesis may be done or a chest tube inserted to remove purulent exudates. (Nursing care of the client undergoing thoracentesis or with a chest tube is discussed later in this chapter.)

Bacteremia can spread the infection to other tissues, leading to meningitis, endocarditis, or peritonitis, and increasing the risk of mortality.

Legionnaires' Disease

Legionnaires' disease is a form of bronchopneumonia caused by *Legionella pneumophila*, a gram-negative bacterium widely found in water, particularly warm, standing water. Legionnaires' disease occurs sporadically and in outbreaks, such as that which occurred at an American Legion convention in 1976, when the disease was first recognized. Contaminated water-cooled air conditioning systems and other water sources have been implicated in its spread.

Smokers, older adults, and people with chronic diseases or impaired immune defenses are most susceptible to Legionnaires' disease. Symptoms develop gradually, beginning 2 to 10 days after exposure. Dry cough, dyspnea, general malaise, chills and fever, headache, confusion, anorexia and diarrhea, myalgias, and arthralgias are common manifestations. Consolidation of lung tissue is patchy or lobar. The mortality rate in Legionnaires' disease is up to 31% without treatment in otherwise healthy people and up to 80% in people who are immunocompromised (Kasper et al., 2005).

Primary Atypical Pneumonia

Pneumonia caused by *Mycoplasma pneumoniae* is generally classified as *primary atypical pneumonia*, because its presentation and course significantly differ from other bacterial pneumonias. Mycoplasma infection often causes pharyngitis or bronchitis. When pneumonia develops, patchy inflammatory changes in the alveolar septum and interstitial tissue of the lung occur. Alveolar exudate and consolidation of lung tissue are not features of atypical pneumonia.

Young adults—college students and military recruits in particular—are the primary affected population. Primary atypical pneumonia is highly contagious. Its manifestations resemble those of viral pneumonia; systemic manifestations of fever, headache, myalgias, and arthralgias often predominate. The cough associated with atypical pneumonia is dry, hacking, and nonproductive. Because of the typically mild nature and predominant systemic manifestations, mycoplasmal and viral pneumonia are often referred to as "walking pneumonias."

Viral Pneumonia

Approximately 10% of pneumonias in adults are viral. Influenza and adenovirus are the most common organisms; however, the incidence of cytomegalovirus (CMV) pneumonia is increasing in immunocompromised people. Other viruses such as herpesviruses and measles virus also may cause viral pneumonia. As in primary atypical pneumonia, lung involvement in viral pneumonia is limited to the alveolar septum and interstitial spaces.

Viral pneumonia is typically a mild disease that often affects older adults and people with chronic conditions. It usually occurs in community epidemics. Flulike symptoms of headache, fever, fatigue, malaise, and muscle aching are common, along with a dry cough.

Pneumocystis Pneumonia

People with acquired immune deficiency syndrome (AIDS) and others with significant immunocompromise are at risk for developing an opportunistic pneumonia caused by *Pneumocystis*, a common parasite found worldwide. Immunity to *Pneumocystis* is nearly universal, except in immunocompromised people. Opportunistic infection may develop in people treated with immunosuppressive or cytotoxic drugs for cancer or organ transplant and in people with genetic or acquired immunodeficiency. People with AIDS account for most cases (60%) of *Pneumocystis* pneumonia (PCP) (Copstead & Banasik, 2005).

Infection with *Pneumocystis* produces patchy involvement throughout the lungs, causing affected alveoli to thicken, become edematous, and fill with foamy, protein-rich fluid. Gas exchange is severely impaired as the disease progresses.

PCP has an abrupt onset with fever, tachypnea and shortness of breath, and a dry, nonproductive cough. Respiratory distress can be significant, with intercostal retractions and cyanosis.

Table 38–3 compares the manifestations of infectious pneumonias.

Aspiration Pneumonia

Aspiration of gastric contents into the lungs results in a chemical and bacterial pneumonia known as *aspiration pneumonia*. Major risk factors for aspiration pneumonia include emergency surgery or obstetric procedures, depressed cough and gag reflexes, and impaired swallowing. Older surgical clients are at significant risk. Enteral nutrition by either nasogastric or gastric tube also increases the risk for aspiration pneumonia. Vomiting is not always apparent; silent regurgitation of gastric contents may occur when the level of consciousness is decreased. Measures to reduce the risk for aspiration pneumonia include minimizing the use of preoperative medications, promoting anesthetic elimination from the body, and preventing nausea and gastric distention.

The low pH of gastric contents causes a severe inflammatory response when aspirated into the respiratory tract. Pulmonary edema and respiratory failure may result. Common complications of aspiration pneumonia include abscesses, bronchiectasis (chronic dilation of the bronchi and bronchioles), and gangrene of pulmonary tissue.

INTERDISCIPLINARY CARE

Prevention is a key component in managing pneumonia. Identifying vulnerable populations and instituting preventive strategies are measures to reduce the mortality and morbidity associated with pneumonia. With early identification of the infecting organism, appropriate treatment, and support of respiratory function, most clients recover uneventfully. However, pneumonia remains a serious disease with significant mortality, especially in aged and debilitated populations.

Diagnosis

The history and physical examination, along with diagnostic testing, are used to establish the diagnosis, determine the extent of lung involvement, and identify the causative organism. See Chapter 36 for more information about the following tests and their nursing implications:

- *Chest x-ray* is obtained to determine the extent and pattern of lung involvement. Fluid, infiltrates, consolidated lung tissue, and atelectasis (areas of alveolar collapse) appear as densities on the film. The *CT scan* provides a more detailed image of pulmonary tissue and may be used when the chest x-ray is not diagnostic.
- *Sputum Gram stain* rapidly identifies the infecting organisms as gram-positive or gram-negative bacteria. Antibiotic therapy can then be directed at the predominant type of organism until culture and sensitivity results are obtained.
- *Sputum culture and sensitivity* is ordered to identify the infecting organism and determine the most effective antibiotic therapy. When obtaining sputum for culture, it is important to obtain secretions from the lower respiratory tract, not the mouth and nasal passages. See Procedure 36–1 on page 1220.

TABLE 38–3 Manifestations of Infectious Pneumonias

TYPE	ONSET	RESPIRATORY MANIFESTATIONS	SYSTEMIC MANIFESTATIONS
Pneumococcal or lobar pneumonia	Abrupt	Cough productive of purulent or rust-colored sputum; pleuritic or aching chest pain; decreased breath sounds and crackles over affected area; possible dyspnea and cyanosis	Chills and fever
Bronchopneumonia	Gradual	Cough, scattered crackles; minimal dyspnea and respiratory distress	Low-grade fever
Legionnaires' disease	Gradual	Dry cough; dyspnea	Chills and fever; general malaise; headache; confusion; anorexia and diarrhea; myalgias and arthralgias
Primary atypical pneumonia	Gradual	Dry, hacking, nonproductive cough	Fever, headache, myalgias, and arthralgias predominate
Viral pneumonia	Sudden or gradual	Dry cough	Flulike symptoms
Pneumocystis pneumonia	Abrupt	Dry cough; tachypnea and shortness of breath; significant respiratory distress	Fever

- *Complete blood count (CBC) with white blood cell (WBC) differential* shows an elevated WBC (11,000/mm^3 or higher) with increased circulating immature leukocytes (a left shift) in response to the infectious process. White blood cell changes are minimal in viral and other pneumonias.
- *Serology testing*, blood tests to detect antibodies to respiratory pathogens, may be used to identify the infecting organism when blood and sputum cultures are negative.
- *Pulse oximetry*, a noninvasive method of measuring arterial oxygen saturation, is ordered to continuously monitor gas exchange. The SaO_2 normally is 95% or higher. An Sao_2 of less than 95% may indicate impaired alveolar gas exchange.
- *Arterial blood gases (ABGs)* may be ordered to evaluate gas exchange. Respiratory secretions or pleuritic pain can interfere with alveolar ventilation. Alveolar inflammation can interfere with gas exchange across the alveolar-capillary membrane, especially if exudate or consolidation is present. An arterial oxygen tension (Pao_2) of less than 75 to 80 mmHg indicates impaired gas exchange or alveolar ventilation. See Chapters 10 and 36 ∞ for more information about gas transport, ABGs, and normal or expected values.
- *Fiberoptic bronchoscopy* may be done to obtain a sputum specimen or remove secretions from the bronchial tree (Figure 36–9). Nursing responsibilities related to bronchoscopy are summarized in the Diagnostic Tests box in Chapter 36 ∞.

Immunization

Vaccines offer some degree of protection against the most common bacterial and viral pneumonias.

Pneumococcal vaccine, made of antigens from 23 types of pneumococcus, usually imparts lifetime immunity with a single dose. The vaccine is recommended for people who have a high risk of adverse outcome from bacterial pneumonias: people over age 65; those with chronic cardiac or respiratory conditions, diabetes mellitus, alcoholism, or other chronic diseases; and immunocompromised people. A one-time revaccination is recommended for selected populations, including people over age 65 who were immunized more than 5 years previously and before age 65, people with chronic renal failure or immunosuppressive conditions (e.g., malignancy), and people receiving chemotherapy with selected agents (CDC, 2005).

Influenza vaccine is also recommended for high-risk populations. The predominant strain of influenza virus varies from year to year. A new vaccine formulation is prepared yearly, incorporating antigens of the influenza strains predicted to be the most prevalent for the upcoming flu season (typically the winter months). Vulnerable populations for whom yearly vaccine is recommended include those listed above as well as healthcare workers and residents of long-term care facilities. The vaccine contains egg protein, and is not recommended for people who have a severe allergy to eggs or who have previously experienced a severe hypersensitivity response to the vaccine.

Medications

Medications used to treat pneumonia may include antibiotics to eradicate the infection and bronchodilators to reduce bronchospasm and improve ventilation.

Initial antibiotic therapy is based on the results of sputum Gram stain and the pattern of lung involvement shown on a chest x-ray. Considerations such as the presence of cardiovascular disease or residence in a long-term care facility also are considered in the initial antibiotic choice. Typically, a broad-spectrum antibiotic such as a macrolide (e.g., clarithromycin, azithromycin, or erythromycin), a penicillin or a second- or third-generation cephalosporin, or a fluoroquinolone (e.g,. ciprofloxacin) is ordered until the results of sputum culture and sensitivity tests are available. Table 38–4 lists commonly prescribed antibiotics for selected pneumonias; nursing implications for selected antibiotics are summarized in Chapter 12 ∞.

When an inflammatory response to the infection causes bronchospasm and constriction, bronchodilators may be ordered to improve ventilation and reduce hypoxia. Bronchodilators generally belong to one of two major groups: the

TABLE 38–4 **Antibiotic Therapy for Selected Pneumonias**

CAUSATIVE ORGANISM	ANTIBIOTIC OF CHOICE	ALTERNATIVE ANTIBIOTICS
Streptococcus pneumoniae	Penicillin G; amoxicillin	Erythromycin, cephalosporins, doxycycline, fluoroquinolone, clindamycin, vancomycin, trimethoprim-sulfamethoxazole (TMP-SMZ), linezolid
Haemophilus influenzae	Second- or third-generation cephalosporins, doxycycline, azithromycin, TMP-SMZ	Fluoroquinolones, clarithromycin
Staphylococcus aureus	Penicillinase-resistant penicillin (e.g., nafcillin); vancomycin for methicillin-resistant organisms	Cephalosporins, vancomycin, clindamycin; ciprofloxacin, fluoroquinolones, TMP-SMZ
Mycoplasma pneumoniae	Erythromycin, doxycycline	Clarithromycin, azithromycin, fluoroquinolone
Klebsiella pneumoniae	Third-generation cephalosporin (with aminoglycoside if severe); metronidazole	Aztreonam, imipenem-cilastatin, fluoroquinolone
Legionella pneumophila	Macrolide + rifampin; fluoroquinolone	TMP-SMZ, doxycycline + rifampin
Pneumocystis	TMP-SMZ, pentamidine + prednisone	Dapsone + trimethoprim, clindamycin + primaquine, trimetrexate + folinic acid
Chlamydia pneumoniae	Doxycycline	Macrolide, fluoroquinolone

sympathomimetic drugs, such as albuterol sulfate (Proventil) and metaproterenol (Alupent); or the methylxanthines, such as theophylline and aminophylline. Use of these drugs and related nursing implications are discussed in detail in the section on asthma in Chapter 39 ∞.

An agent to "break up" mucus or reduce its viscosity may be prescribed. Acetylcysteine (Mucomyst), potassium iodide, and guaifenesin (a common ingredient in expectorant cough syrups) help to liquefy mucus, making it easier to expectorate. For many clients, however, increasing fluid intake is an effective means of liquefying mucus.

Treatments

When mucous secretions are thick and viscous, increasing fluid intake to 2500 to 3000 mL per day helps liquefy secretions, making them easier to cough up and expectorate. If the client is unable to maintain an adequate oral intake, intravenous fluids and nutrition may be required.

Incentive spirometry may be used to promote deep breathing, coughing, and clearance of respiratory secretions. Endotracheal suctioning may be required if the cough is ineffective. This invasive technique is discussed in Chapter 39 ∞ in the section describing nursing care for the client with acute respiratory failure. On occasion, bronchoscopy is used to perform pulmonary toilet and remove secretions.

OXYGEN THERAPY Oxygen therapy may be indicated for the client who is tachypneic or hypoxemic.

Inflammation of the alveolar-capillary membrane interferes with diffusion of gases across the membrane. Diffusion is affected by several other factors, including the partial pressure of gases on each side of the membrane. Increasing the percentage of inspired oxygen above that of room air (21%) increases the partial pressure of oxygen in the alveoli and enhances its diffusion into the capillaries. Supplemental oxygen therefore improves oxygenation of the blood and tissues in clients with pneumonia.

Depending on the degree of hypoxia, oxygen may be administered by either a low-flow or high-flow system. Low-flow systems include the nasal cannula, simple face mask, partial rebreathing mask, and nonrebreathing mask (Figure 38–3 ■). A nasal cannula can deliver 24% to 45% oxygen concentrations with flow rates of 2 to 6 L/min. The nasal cannula is comfortable and does not interfere with eating or talking. A simple face mask delivers 40% to 60% oxygen concentrations with flow rates of 5 to 8 L/min. Up to 100% oxygen can be delivered by the nonrebreather mask, the highest concentration possible without mechanical ventilation. When the amount of oxygen delivered must be precisely regulated, a high-flow system such as a Venturi mask is used (Figure 38–4 ■). The Venturi mask regulates the ratio of oxygen to room air, allowing precise regulation of the oxygen percentage delivered, from 24% to 50%. Severe hypoxia may necessitate intubation and mechanical ventilation. Endotracheal intubation and methods of mechanical ventilation are discussed in Chapter 39 ∞.

CHEST PHYSIOTHERAPY Chest physiotherapy, including percussion, vibration, and postural drainage, may be prescribed to reduce lung consolidation and prevent atelectasis.

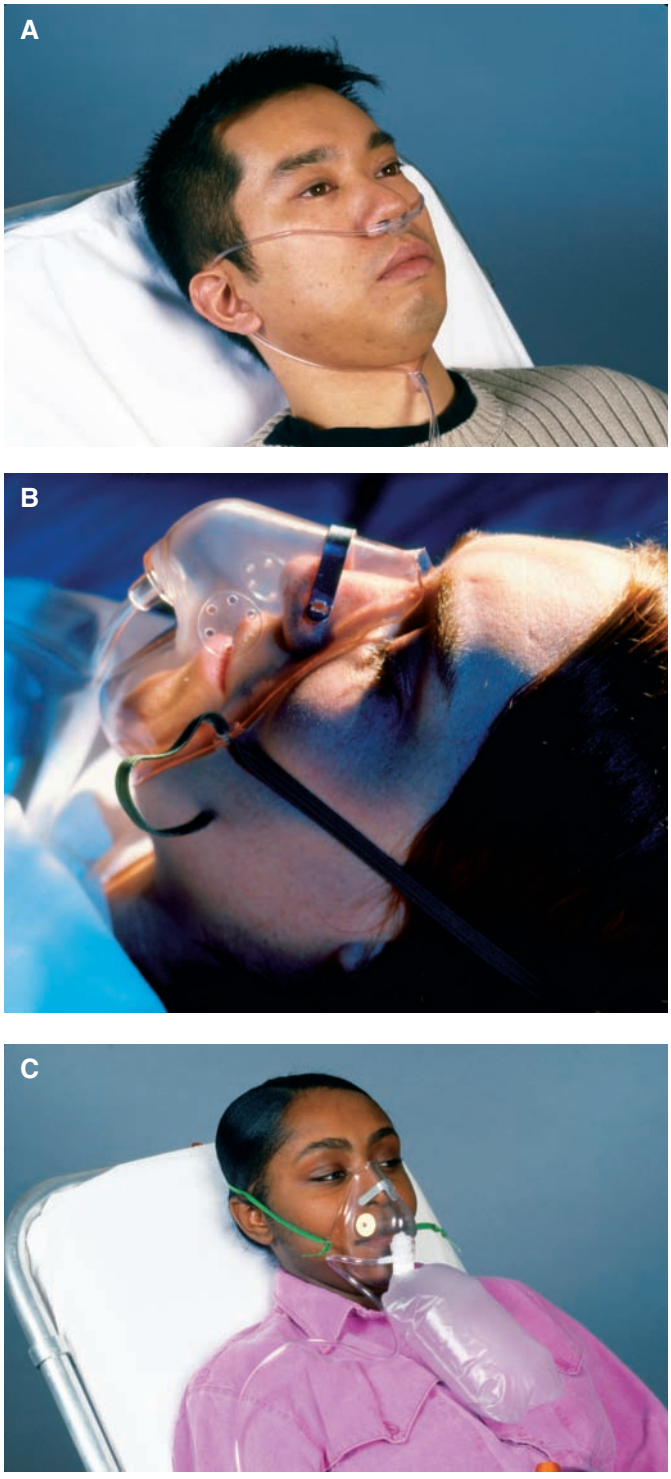


Figure 38–3 ■ Low-flow oxygen delivery devices: *A,* nasal cannula; *B,* simple face mask; *C,* nonrebreather mask.

Source: A, C, Michal Heron, Pearson Education/PH College; *B,* Tony McConnell, Photo Researchers, Inc.

Percussion is performed by rhythmically striking or clapping the chest wall with cupped hands (Figure 38–5A ■), using rapid wrist flexion and extension. Cupping traps air between the palm and the client's skin, setting up vibrations through the chest wall that loosen respiratory secretions. The trapped air also provides a cushion, preventing injury. When per-

Figure 38–4 ■ Venturi mask, a high-flow oxygen delivery system.
Source: Michal Heron, Pearson Education/PH College

formed correctly, percussion produces a hollow, popping sound. Percussion may also be done using a mechanical percussion cup. The breasts, sternum, spinal column, and kidney regions are avoided during percussion.

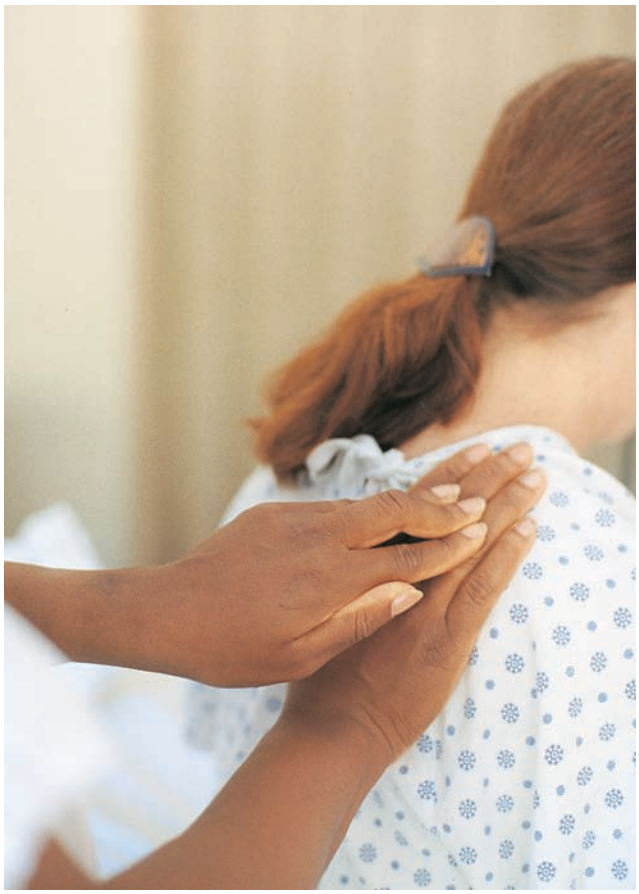
Vibration facilitates secretion movement into larger airways. It usually is combined with percussion, although it may be used when percussion is contraindicated or poorly tolerated. Vibration is performed by repeatedly tensing the arm and hand muscles while maintaining firm but gentle pressure over the affected area with the flat of the hand (Figure 38–5B).

Percussion and vibration are done in conjunction with *postural drainage*, which uses gravity to facilitate removal of secretions from a particular lung segment. The client is positioned with the segment to be drained superior to or above the trachea or mainstem bronchus. Drainage of all lung segments requires a variety of positions (Figure 38–6 ■); rarely do all segments require drainage. Bronchodilators or nebulizer treatments are administered as ordered prior to postural drainage. It is best to perform postural drainage before meals to avoid nausea and vomiting.

Complementary Therapies

Although complementary therapies do not replace conventional treatment for pneumonia, they often promote comfort and speed recovery. The herb echinacea is widely used to stimulate immune function and treat URIs. Because viral URIs often precede pneumonia, echinacea may be helpful in preventing pneumonia. Recent research, however, shows mixed results for the effectiveness of echinacea in reducing the duration and severity of URI (National Center for Complementary and Alternative Medicine [NCCAM], 2005). Goldenseal, which often is sold in combination with echinacea, is used to treat bacterial, fungal, and protozoal infections of the mucous membranes of the respiratory tract.

A



B

Figure 38–5 ■ *A,* Percussing (clapping) the upper posterior chest. Notice the cupped position of the nurse's hands. *B,* Vibrating the upper posterior chest.

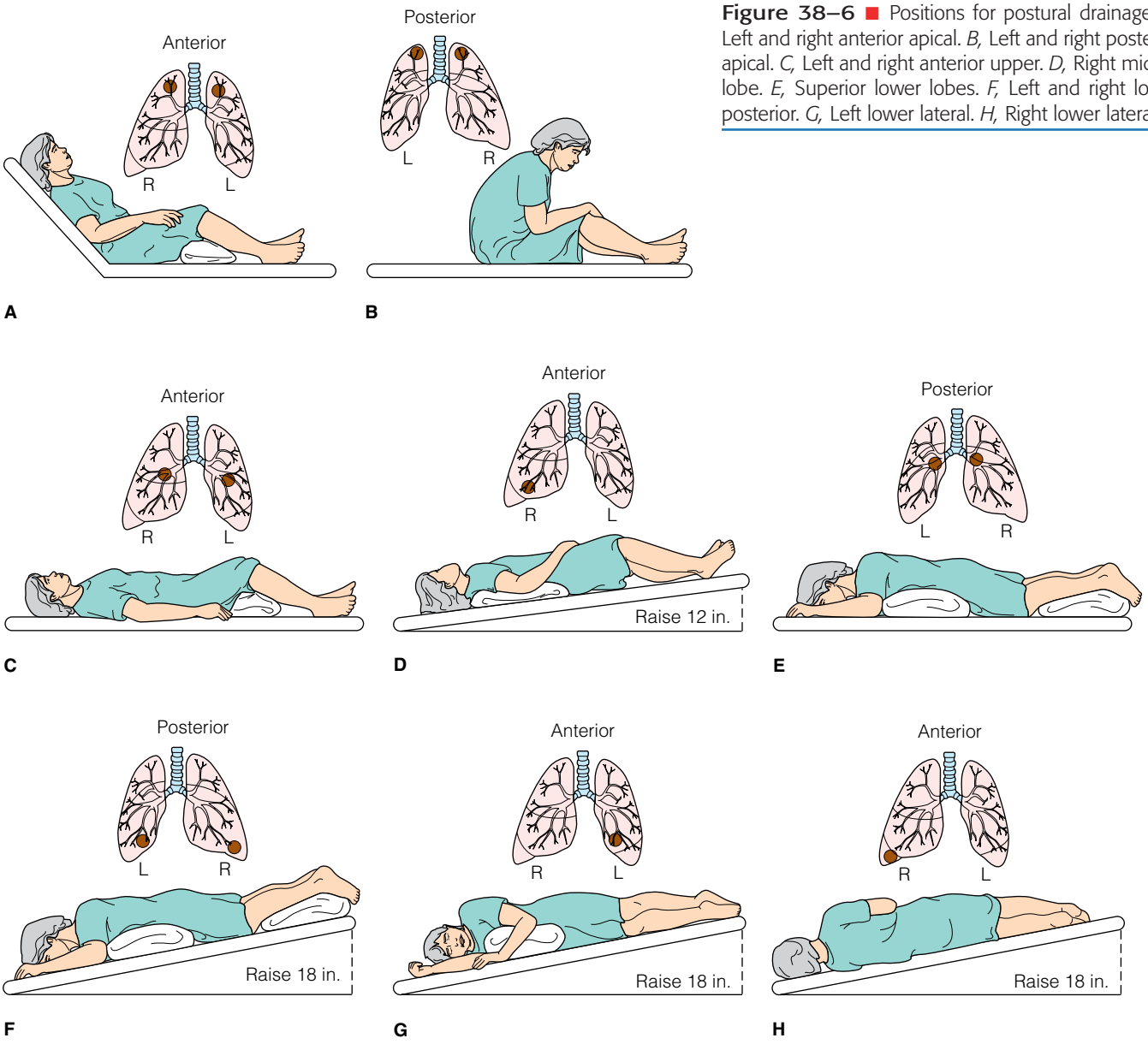


Figure 38–6 ■ Positions for postural drainage. *A,* Left and right anterior apical. *B,* Left and right posterior apical. *C,* Left and right anterior upper. *D,* Right middle lobe. *E,* Superior lower lobes. *F,* Left and right lower posterior. *G,* Left lower lateral. *H,* Right lower lateral.

Ma huang contains the active ingredient ephedra, which has been used to relieve bronchospasm and ease breathing. The primary active ingredient in ephedra is epinephrine, a cardiac and CNS stimulant. Because of the dangers associated with its use, sale of herbal products containing ephedra has been banned (NCCAM, 2004). Advise clients inquiring about the use of Chinese herbal remedies to reduce pneumonia symptoms to inquire if any recommended product contains ma huang or ephedra, and to avoid such products.

NURSING CARE

Health Promotion

Health promotion activities focus on pneumonia prevention. Make clients in high-risk groups aware of the benefits of immunizations against influenza and pneumococcal pneumonia. A single dose of pneumococcus vaccine usually produces immunity to most strains of pneumococcal pneumonia, although repeat doses may be needed for older adults and people who are immunosuppressed. (Pneumococcus vaccine is contraindicated for people receiving immunosuppressive therapy.) Annual influenza vaccine helps prevent pneumonia, because pneumonia often occurs as a sequela to influenza.

PRACTICE ALERT

Inquire about allergic responses to eggs or previous influenza vaccinations prior to administering influenza vaccine. A significant hypersensitivity response may occur in clients who are allergic to egg protein.

Additional measures to screen for and detect pneumonia in older adults are appropriate. Frequent pulmonary assessment and aggressive interventions help prevent problems. Restoring and maintaining mobility improves ventilation and helps mobilize secretions. Promoting adequate fluid intake is nec-

essary because fluid helps liquefy secretions, making them easier to expectorate.

Assessment

Focused assessment of the client with pneumonia includes the following:

- *Health History:* Current symptoms and their duration; presence of shortness of breath or difficulty breathing, chest pain and its relationship to breathing; cough, productive or nonproductive, color, consistency of sputum; other symptoms; recent upper respiratory or other acute illness; chronic diseases such as diabetes, chronic lung disease, or heart disease; current medications; medication allergies.
- *Physical Examination:* Presentation, apparent distress; level of consciousness; vital signs including temperature; skin color, temperature; respiratory excursion, use of accessory muscles of respiration; lung sounds.
- *Diagnostic Tests:* WBC with differential, sputum Gram stain, culture and sensitivity, chest x-ray or CT scan.

Nursing Diagnoses and Interventions

Clients with lower respiratory disorders such as pneumonia may have multiple nursing care needs, depending on the severity of the illness. Alveolar ventilation and the process of alveolar respiration can be affected by inflammation and secretions. **Hypoxemia**, low levels of oxygen in the blood, and tissue hypoxia may result. Nursing care focuses on supporting optimal respiratory function and promoting rest to reduce metabolic and oxygen needs. Priority nursing diagnoses include *Ineffective Airway Clearance, Ineffective Breathing Pattern*, and *Activity Intolerance*.

Ineffective Airway Clearance

The inflammatory response to infection causes tissue edema and exudate formation. In the lungs, the inflammatory response can narrow and potentially obstruct bronchial passages and alveoli. Assessment findings supporting this nursing diagnosis include adventitious breath sounds such as crackles (rales), rhonchi, and wheezes; dyspnea and tachypnea; coughing; and indicators of hypoxia such as cyanosis, reduced Sao_2 levels, anxiety, and apprehension.

- Assess respiratory status, including vital signs, breath sounds, Sao_2, and skin color at least every 4 hours. *Early identification of respiratory compromise allows intervention before tissue hypoxia is significant.*
- Assess cough and sputum (amount, color, consistency, and possible odor). *Assessment of the cough and nature of sputum produced allows evaluation of the effectiveness of respiratory clearance and the response to therapy.*
- Monitor ABG results; report increasing hypoxemia and other abnormal results to the physician. *Blood gas changes may be an early indicator of impaired gas exchange due to airway narrowing or obstruction.*
- Place in Fowler's or high-Fowler's position. Encourage frequent position changes and ambulation as allowed. *The upright position promotes lung expansion; position changes and ambulation facilitate the movement of secretions.*
- Assist to cough, deep breathe, and use assistive devices. Provide endotracheal suctioning using aseptic technique as ordered. *Coughing, deep breathing, and suctioning help clear airways.*
- Provide a fluid intake of at least 2500 to 3000 mL per day. *A liberal fluid intake helps liquefy secretions, facilitating their clearance.*
- Work with the physician and respiratory therapist to provide pulmonary hygiene measures, such as postural drainage, percussion, and vibration. *These techniques help mobilize and clear secretions.*
- Administer prescribed medications as ordered, and monitor their effects. *If the infecting organism is resistant to the prescribed antibiotic, little improvement may be seen with treatment. Bronchodilators help maintain open airways but may have adverse effects such as anxiety and restlessness.*

Ineffective Breathing Pattern

Pleural inflammation often accompanies pneumonia, causing sharp localized pain that increases with deep breathing, coughing, and movement, which can lead to rapid and shallow breathing. Distal airways and alveoli may not expand optimally with each breath, increasing the risk for atelectasis and decreasing gas exchange. Fatigue from the increased work of breathing is an additional problem in pneumonia. This, too, can lead to decreased lung inflation and an ineffective breathing pattern.

PRACTICE ALERT

Assess respiratory rate, depth, and lung sounds at least every 4 hours. Tachypnea and diminished or adventitious breath sounds may be early indicators of respiratory compromise.

- Provide for rest periods. *Rest reduces metabolic demands, fatigue, and the work of breathing, promoting a more effective breathing pattern.*
- Assess for pleuritic discomfort. Provide analgesics as ordered. *Adequate pain relief minimizes splinting and promotes adequate ventilation.*
- Provide reassurance during periods of respiratory distress. *Hypoxia and respiratory distress produce high levels of anxiety, which tends to further increase tachypnea and fatigue and decrease ventilation.*
- Administer oxygen as ordered. *Oxygen therapy increases the alveolar oxygen concentration and facilitates its diffusion across the alveolar-capillary membrane, reducing hypoxia and anxiety.*
- Teach slow abdominal breathing. *This breathing pattern promotes lung expansion.*
- Teach use of relaxation techniques, such as visualization and meditation. *These techniques help reduce anxiety and slow the breathing pattern.*

Activity Intolerance

Impaired airway clearance and gas exchange interfere with oxygen delivery to body cells and tissues. At the same time, the infectious process and the body's response to it increase metabolic demands on the cells. The net result of this imbalance between

MEDIALINK Care Plan Activity: Pneumonia

oxygen delivery and oxygen demand is a lack of physiologic energy to maintain normal daily activities.

- Assess activity tolerance, noting any increase in pulse, respirations, dyspnea, diaphoresis, or cyanosis. *These assessment findings may indicate limited or impaired activity tolerance.*

PRACTICE ALERT

Activity intolerance may be an early sign of cardiorespiratory compromise, particularly in the older adult or client with preexisting heart disease. New or worsening manifestations of activity intolerance should be reported to the physician.

- Assist with self-care activities, such as bathing. *Assistance with ADLs reduces energy demands.*
- Schedule activities, planning for rest periods. *Rest periods minimize fatigue and improve activity tolerance.*
- Provide assistive devices, such as an overhead trapeze. *These assistive devices facilitate movement and reduce energy demands.*
- Enlist the family's help to minimize stress and anxiety levels. *Stress and anxiety increase metabolic demands and can decrease activity tolerance.*
- Perform active or passive range-of-motion (ROM) exercises. *Exercises help maintain muscle tone and joint mobility, and prevent contractures if bed rest is prolonged.*
- Provide emotional support and reassurance that strength and energy will return to normal when the infectious process has resolved and the balance of oxygen supply and demand is restored. *The client may be concerned that activity intolerance will continue to be a problem after the acute infection is resolved.*

Using NANDA, NIC, and NOC

Links between NANDA nursing diagnoses, NIC, and NOC for the client with pneumonia are outlined in Chart 38–1.

Community-Based Care

Clients with pneumonia usually are treated in the community, unless their respiratory status is significantly compromised (e.g., altered mental status, tachypnea, tachycardia, hypotension, hypo- or hyperthermia, and altered blood gases) or if risk factors such as advanced age and/or coexisting heart, kidney, or liver disease are present.

Discuss the following topics when preparing the client and family for home care:

- The importance of completing the prescribed medication regimen as ordered; potential drug side effects and their management, including manifestations that necessitate stopping the drug and notifying the physician
- Recommendations for limiting activities and increasing rest
- Maintaining adequate fluid intake to keep mucus thin for easier expectoration
- Ways to maintain adequate nutritional intake, such as small, frequent, well-balanced meals
- The importance of avoiding smoking or exposure to secondhand smoke to prevent further irritation of the lungs

NANDA, NIC, AND NOC LINKAGES

CHART 38–1 **The Client with Pneumonia**

NANDA

Ineffective Airway Clearance

↓

NIC

Cough Enhancement

Chest Physiotherapy

Respiratory Monitoring

Positioning

↓

NOC

Respiratory Status: Airway Patency

Respiratory Status: Ventilation

Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA Interational (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

- Manifestations to report to the physician, such as increasing shortness of breath, difficulty breathing, increased fever, fatigue, headache, sleepiness, or confusion
- The importance of keeping all follow-up appointments to ensure disease cure.

The accompanying Nursing Care Plan provides further nursing interventions for clients treated in the community.

Clients with respiratory compromise or who are elderly or debilitated may require home care assistance to remain at home. Provide referrals to home intravenous services, home health nursing services, and home maintenance services as indicated. Community services such as Meals-on-Wheels can provide support to reduce the energy demands of meal preparation.

THE CLIENT WITH SEVERE ACUTE RESPIRATORY SYNDROME

Severe acute respiratory syndrome (SARS) is a lower respiratory illness of unknown etiology first described in people in Asia in the fall of 2002. Since then, this emerging disease has been identified in clients in North America, Australia, and Europe, although the majority of identified cases are in China (including Hong Kong and Singapore) (World Health Organization, 2003). The primary population affected by SARS is previously healthy adults ages 25 to 70 years.

Pathophysiology

The infective agent responsible for SARS is a coronavirus not previously identified in humans. This virus appears to spread

NURSING CARE PLAN A Client with Pneumonia

Mary O'Neal is a 35-year-old executive assistant and a part-time college student. On returning home from class one evening, she begins to chill. She alternates between chills and sweats all night. Staying home from work, she remains in bed most of the next day. Her fever continues, and she develops a cough and dull aching chest pain. When the cough becomes productive of rust-colored sputum the following day, she seeks medical treatment from her family doctor.

ASSESSMENT

Debby Kowalski, RN, the family practice clinic nurse, admits Mrs. O'Neal to the clinic and obtains the nursing assessment. Mrs. O'Neal denies any previous history of respiratory diseases "other than the usual colds, flu, and such." She also denies any history of smoking or medication allergies. She says her symptoms began abruptly with the onset of the chills. She describes her chest pain as a dull ache that was initially substernal but now is localized in her lower lateral right chest. The pain increases with deep breathing, coughing, and moving. Her cough is increasing in frequency and severity, and her sputum appears rusty brown. Her vital signs are BP 116/74, P 104 and regular, R 26, T 101.8°F (38.7°C). Skin warm and flushed, with no evidence of cyanosis. Respirations shallow, unlabored; respiratory excursion equal. Diminished breath sounds in bases bilaterally, crackles noted in right posterior and lateral base. Faint pleural rub heard at right midaxillary line.

A STAT CBC shows a WBC of 18,900/mm^3; differential shows increased numbers of neutrophils and immature WBCs (bands). Ms. Kowalski has Mrs. O'Neal rinse with an antiseptic mouthwash and then collects a sputum specimen for culture and Gram stain prior to seeing the physician.

The physician orders a chest x-ray after examining Mrs. O'Neal. Based on her history, examination, and the chest x-ray, he makes the diagnosis of acute bacterial pneumonia, probably pneumococcal. He prescribes oral penicillin V, 500 mg every 6 hours for 10 days. He asks Mrs. O'Neal to return for a follow-up appointment in 10 days and refers her back to Ms. Kowalski for appropriate teaching.

DIAGNOSES

- *Ineffective Breathing Pattern* related to pleuritic chest pain
- *Hyperthermia* related to inflammatory process
- *Deficient Knowledge* about pneumonia and its treatment

EXPECTED OUTCOMES

- Maintain normal pulmonary function.
- Describe measures to minimize elevations in body temperature.
- Identify a schedule for taking her medication that will facilitate compliance with the regimen.
- Describe manifestations that should be reported to the physician.

PLANNING AND IMPLEMENTATION

- Assess knowledge and understanding of pneumonia and its effects.
- Assist to develop a medication schedule that coordinates with normal daily routine.
- Teach about the following:
  a. Importance of avoiding use of a cough suppressant except at night to facilitate rest
  b. Ways to increase fluid intake to reduce fever and maintain thin mucus for easy expectoration
  c. Beneficial effects of rest, especially during the acute phase of her illness
  d. Safe use of aspirin and acetaminophen to reduce fever
  e. Importance of taking all prescribed medication doses as scheduled
  f. Common side effects of penicillin V and their management
  g. Early manifestations of penicillin allergy that necessitate stopping the medication and notifying the physician
  h. Signs of complications of pneumonia or worsening pneumonia to report.

EVALUATION

The sputum culture confirms *S. pneumoniae* as the cause of Mrs. O'Neal's pneumonia. When she returns for her follow-up appointment, she reports that she began to feel better after 2 days on the penicillin and returned to work the following Monday. Her examination reveals good breath sounds throughout with no adventitious sounds. The follow-up sputum culture is free of pathogens.

CRITICAL THINKING IN THE NURSING PROCESS

1. Do any of the factors identified in the case study increase Mrs. O'Neal's risk for acute bacterial pneumonia?
2. Mrs. O'Neal's WBC differential showed increased neutrophil and band counts. Describe the reason for and effect of this change.
3. Even though Mrs. O'Neal has no history of medication allergies, anaphylactic shock remains a potential risk. Describe the sequence of events leading to anaphylactic shock, its initial symptoms, and immediate nursing interventions.
4. Had Mrs. O'Neal required hospitalization to treat her acute pneumonia, interruption of her usual activities and responsibilities could lead to anxiety. Develop a care plan for this situation, using the nursing diagnosis *Ineffective Role Performance* related to hospitalization.

See Evaluating Your Response in Appendix C.

primarily by contact with respiratory secretions. Other potential sources of the infection are through direct contact with an infected person or contaminated object, and exposure of the eyes or mucous membranes to respiratory secretions (CDC, 2004). Contact with contaminated water or sewage may transmit the disease, suggesting fecal–oral transmission as well (Kasper et al., 2005).

The virus infects cells of the respiratory tract, leading to surface necrosis and sloughing of pneumocytes in the alveolar spaces and formation of hyaline membranes (a fibrin and protein "film" that interferes with gas exchange within the alveoli). The alveolar damage is accompanied by inflammation of interstitial pulmonary tissues with infiltration by lymphocytes and monocytes. The virus also is found in the blood, urine, and feces.

Manifestations and Complications

The incubation period for SARS is generally 2 to 7 days, although it may be as long as 10 days in some people. Fever higher than 100.4°F (38°C) is typically the initial manifestation of the disease. The high fever may be accompanied by chills, headache, malaise, and muscle aches. After 1 to 2 days, respiratory manifestations of SARS develop, including nonproductive cough, shortness of breath, dyspnea, and possible hypoxemia. Respiratory symptoms may worsen, progressing to respiratory distress, during the second week of the illness.

Although the majority of people with SARS recover, up to 20% of affected clients require intubation and mechanical ventilation (see Chapter 39 ∞). Acute respiratory distress syndrome (ARDS) or multiorgan dysfunction (see Chapter 11 ∞) may develop. The overall mortality rate for SARS is about 11%. The disease is less severe in children than in adults (Kasper et al., 2005).

INTERDISCIPLINARY CARE

Prompt identification of SARS, infection control measures, and reporting of the disease are vital to control this potentially fatal disease. Healthcare providers and public health personnel should report cases of SARS to state and local health departments.

Diagnosis

Diagnostic testing for SARS may include the following:

- *Serology tests* (including enzyme-linked immunosorbent assay [ELISA] or immunofluorescence tests) for antibodies to the coronavirus may performed, but often are undetectable during the acute stage of the illness.
- *Reverse-transcriptase polymerase chain reaction (RT-PCR)* testing of respiratory and blood samples provides a rapid mechanism for identifying the virus, but only about 33% of early samples are positive.
- *Chest x-ray* may be normal or show interstitial infiltrates in a focal or generalized patchy pattern. In late stages of SARS, consolidation may be evident.
- *Pulse oximetry (oxygen saturation)* often shows hypoxemia in the respiratory phase of the illness.
- *CBC* often demonstrates a low lymphocyte count early in the disease. Leukopenia and thrombocytopenia may develop at the peak of the respiratory illness.
- *Creatinine phosphokinase (CPK or CK), ALT*, and *AST* levels may be markedly increased in SARS.
- *Sputum specimen* is obtained. Gram stain and culture are performed on the specimen to rule out other causes of pneumonia.
- *Blood culture* may be done to identify possible bacteremia.

Medications

At this time, no medications have been shown to be consistently effective in treating SARS. Antibiotic and/or antiviral therapy targeted at community-acquired forms of pneumonia may be administered if the diagnosis is unclear.

Infection Control

Because healthcare workers are at risk for developing SARS after caring for infected clients, infection control precautions should be immediately instituted when SARS is suspected. Standard precautions (see Appendix A ∞) are implemented along with contact and airborne precautions. The CDC (2005) recommends hand hygiene, gown, gloves, eye protection, and an N95 respirator to prevent transmission of SARS in healthcare settings.

When clients with SARS are managed in the community, they are advised to remain home for 10 days after the fever has resolved and until respiratory symptoms are absent or minimal. Members of the household are advised to wash hands frequently or use alcohol-based hand rubs. The client is advised to cover the mouth and nose with tissue when coughing or sneezing and to wear a surgical mask during close contact with uninfected people. Sharing of utensils, towels, and bedding should be avoided. Routine cleaning (e.g., washing with soap and hot water) is adequate to disinfect objects and no special precautions are necessary for disposing of waste.

Treatments

Care of the client with SARS is supportive. Oxygen may be administered to treat hypoxemia. Intubation and mechanical ventilation may be required if respiratory failure or ARDS develops.

NURSING CARE

Nursing care of the client with SARS focuses on preventing spread of the disease to others and providing respiratory support.

Health Promotion

Use respiratory and contact infection control precautions in addition to standard precautions when caring for all clients with suspected SARS to prevent spread of the disease to healthcare workers or other clients.

Assessment

Focused assessment data for the client with suspected SARS include the following. For more complete respiratory assessment, see Chapter 36 ∞.

- *Health History:* Current symptoms, including fever, malaise, shortness of breath, and cough; onset of symptoms; recent international travel or exposure to a person known to have SARS.
- *Physical Assessment:* Vital signs including temperature; respiratory status, including respiratory rate, depth, and effort; presence of cough; adventitious lung sounds.

Nursing Diagnoses and Interventions

The client with SARS poses a risk for spread of the infection to healthcare workers and others. In addition, while many people with this disease experience only mild symptoms and recover fully and uneventfully, others develop severe respiratory distress and may require significant respiratory support. Gas exchange may be impaired, leading to significant hypoxemia. In addition to the nursing diagnoses discussed in the previous section on pneumonia, *Impaired Gas Exchange* and *Risk for Infection* are priority nursing diagnoses.

Impaired Gas Exchange

SARS causes hypoxemia of varying degrees in affected clients. Significant hypoxemia may necessitate intubation and mechanical ventilation to support cellular function until recovery occurs.

- Monitor vital signs, color, oxygen saturation, and ABGs. Assess for manifestations such as anxiety or apprehension, restlessness, confusion, lethargy, or complaints of headache. *These assessment data alert the nurse and care providers to potential hypoxemia or hypercapnia due to impaired gas exchange.*

PRACTICE ALERT

Promptly report signs of respiratory distress, including tachypnea, tachycardia, nasal flaring, use of accessory muscles, intercostal retractions, cyanosis, increasing restlessness, anxiety, or decreased level of consciousness (LOC). These may be early manifestations of respiratory failure and inability to maintain ventilatory effort.

- Promptly report worsening ABGs and oxygen saturation levels. *Close assessment of these values allows timely intervention as needed.*
- Maintain oxygen therapy and mechanical ventilation as ordered. Hyperoxygenate prior to suctioning. *Oxygen and mechanical ventilation support alveolar gas exchange. Hyperoxygenation prior to suctioning reduces the degree of hypoxemia that occurs during suctioning.*
- Place in Fowler's or high Fowler's position. *Sitting positions decrease pressure on the diaphragm and chest, improving lung ventilation and decreasing the work of breathing.*
- Minimize activities and energy expenditures by assisting with activities of daily living (ADLs), spacing procedures and activities, and allowing uninterrupted rest periods. *Rest is vital to reduce oxygen and energy demands.*

PRACTICE ALERT

Avoid sedatives and respiratory depressant drugs unless mechanically ventilated. These medications can further depress the respiratory drive, worsening respiratory failure.

- If intubation and mechanical ventilation are necessary, explain the procedure and its purpose to the client and family, providing reassurance that this *temporary* measure improves oxygenation and reduces the work of breathing. Alert that talking is not possible while the endotracheal tube is in place, and establish a means of communication. *Thorough explanation is important to relieve anxiety.*

See the section in Chapter 39 ∞ on respiratory failure for more information about caring for a client who is intubated and mechanically ventilated.

Risk for Infection

The spread of SARS is a risk both in the healthcare facility and the community in which the client resides. Respiratory and contract precautions are recommended to prevent the spread of SARS via respiratory secretions or contact with the virus.

- Place the client in a private room with airflow control that prevents air within the room from circulating into the hallway or other rooms. A negative flow room in which air is diluted by at least six fresh-air exchanges per hour is recommended. *A negative flow room and multiple fresh-air exchanges dilute the concentration of virus within the room and prevent its spread to adjacent areas.*
- Use standard precautions and respiratory and contact isolation techniques as recommended by the CDC, including wearing respirators, gowns, and eye protection when caring for clients with SARS. *These measures are important to prevent the spread of SARS to others.*
- Discuss the reasons for and importance of respiratory and contact isolation procedures during treatment. *Maintenance of infection control precautions during and immediately following the febrile and respiratory phases of SARS is vital to prevent its spread to healthcare workers and the community.*
- Place a mask on the client when transporting to other parts of the facility for diagnostic or treatment procedures. *Covering the client's nose and mouth during transport minimizes air contamination and the risk to visitors and personnel.*
- Inform all personnel having contact with the client of the diagnosis. *This allows personnel to take appropriate precautions.*
- Assist visitors to mask prior to entering the room. *Providing visitors with appropriate masks or respirators reduces their risk of infection.*
- Teach the client how to limit transmitting the disease to others:
  a. Always cough and expectorate into tissues.
  b. Dispose of tissues properly, placing them in a closed bag.
  c. Wear a mask if sneezing or unable to control respiratory secretions.
  d. Do not share eating utensils, towels, bedding, or other objects with others, because this disease may also be spread by contact with contaminated objects.

  Teaching appropriate precautions helps prevent the spread of SARS to others while allowing as much freedom from restraints as possible.

Community-Based Care

Many clients with SARS experience only mild symptoms and are appropriately cared for in the community. Teaching about home care and infection control precautions is vital to prevent spread of this disease to the community. Include the following topics when teaching for home care:

- The disease, its origin, and how it is spread
- Manifestations of impaired respiratory status to report to the physician
- Preventing spread of the disease to others:
  - Cover the mouth and nose with tissues when coughing or sneezing. Personally dispose of tissues in a paper bag or the garbage. Wear a surgical mask during close contact with other members of the household.
  - Limit interactions outside the home; do not go to work, school, or other public areas until you have been free of fever for 10 days and your respiratory symptoms are resolving.
  - Remind all members of the household to wash hands (or use an alcohol-based hand sanitizer) frequently, particularly after direct contact with body fluids.

- Do not share eating utensils, towels, or bedding with others. These items can be cleaned with soap and hot water between uses. Clean contaminated surfaces with a household disinfectant.
- Monitoring uninfected members of the household for signs of the illness (Instruct to report fever or respiratory symptoms to the physician.)

THE CLIENT WITH LUNG ABSCESS

A **lung abscess** is a localized area of lung destruction or necrosis and pus formation. The most common cause of lung abscess is aspiration and resulting pneumonia. Risk factors, therefore, are those for aspiration: decreased LOC due to anesthesia, injury or disease of the central nervous system (CNS), seizure, excessive sedation, or alcohol abuse; swallowing disorders; dental caries; and debilitation secondary to cancer or chronic disease. Lung abscess also may occur as a complication of some types of pneumonia, including those due to *S. aureus, Klebsiella*, and *Legionella*.

Pathophysiology and Manifestations

A lung abscess forms after lung tissue becomes consolidated (i.e., after alveoli become filled with fluid, pus, and microorganisms). Consolidated tissue becomes necrotic. This necrotic process can spread to involve the entire bronchopulmonary segment and progress proximally until it ruptures into a bronchus. With rupture, the contents of the abscess empty into the bronchus, leaving a cavity filled with air and fluid, a process known as *cavitation*. If purulent material from the abscess is not expectorated, the infection may spread, leading to diffuse pneumonia or a syndrome similar to acute respiratory distress syndrome (discussed in Chapter 39 ∞).

Manifestations of lung abscess typically develop about 2 weeks after the precipitating event (aspiration, pneumonia, and so on). Their onset may be either acute or insidious. Early symptoms are those of pneumonia: productive cough, chills and fever, pleuritic chest pain, malaise, and anorexia. The temperature may be significantly elevated, 103°F (39.4°C) or higher. When the abscess ruptures, the client may expectorate large amounts of foul-smelling, purulent, and possibly blood-streaked sputum. Breath sounds are diminished, and crackles may be noted in the region of the abscess. A dull percussion tone is also present.

INTERDISCIPLINARY CARE

The diagnosis of lung abscess usually is based on the history and presentation. The CBC may indicate leukocytosis. Sputum culture may not show the organism involved unless rupture occurs. Chest x-ray shows a thick-walled, solitary cavity with surrounding consolidation, although differentiating lung abscess from consolidation can be difficult until cavitation occurs.

Lung abscess is treated with antibiotic therapy, usually intravenous clindamycin (Cleocin), amoxicillin-clavulanate (Augmentin), or penicillin (Tierney et al., 2005). Postural drainage may be ordered to relieve obstruction and promote drainage. In some cases, bronchoscopy is used to drain the abscess. If the pleural space becomes involved, a chest tube (*tube thoracostomy*) may be used to drain the abscess. See the section on pneumothorax later in this chapter for further discussion of chest tubes.

NURSING CARE

Although most clients with lung abscess recover fully with appropriate antibiotic treatment, rupture and drainage of the abscess into a bronchus is a frightening experience. Nursing care needs of the client relate primarily to maintaining a patent airway and adequate gas exchange. The following nursing diagnoses may be appropriate for the client with lung abscess:

- *Risk for Ineffective Airway Clearance* related to large amounts of purulent drainage in bronchi
- *Impaired Gas Exchange* related to necrotic and consolidated lung tissue
- *Hyperthermia* related to infectious process
- *Anxiety* related to copious amounts of purulent sputum.

Health education for the client and family focuses on the importance of completing the prescribed antibiotic therapy. Most lung abscesses are successfully treated with antibiotics; however, treatment may last up to 1 month or more. Emphasize the importance of completing the entire course of therapy to eliminate the infecting organisms. Teach about the medication, including its name, dose, and desired and adverse effects. Stress the need to contact the physician if symptoms do not improve or if they become worse. Infection from lung abscess can spread not only to lung and pleural tissue but systemically, causing sepsis. If postural drainage is ordered, teach the client and family how to perform this procedure. When procedures such as bronchoscopy or thoracostomy are performed to drain the abscess, provide preoperative teaching and instruction on postoperative care.

THE CLIENT WITH TUBERCULOSIS

Tuberculosis (TB) is a chronic, recurrent infectious disease that usually affects the lungs, although any organ can be affected. This disease, caused by *Mycobacterium tuberculosis*, is uncommon in the United States, especially among young adults of European descent.

M. tuberculosis is a relatively slow-growing, slender, rod-shaped, acid-fast organism with a waxy outer capsule, which increases its resistance to destruction. Although the lungs are usually infected, tuberculosis can involve other organs as well. It is transmitted by *droplet nuclei*, airborne droplets produced when an infected person coughs, sneezes, speaks, or sings. The tiny droplets can remain suspended in air for several hours. Infection may develop when a susceptible host breathes in air containing droplet nuclei and the contaminated particle eludes the normal defenses of the upper respiratory tract to reach the alveoli.

Incidence and Prevalence

The incidence of tuberculosis fell steadily until the mid-1980s, thanks to improved sanitation, surveillance, and treatment of people with active disease. The late 1980s and early 1990s saw a

resurgence of the disease, attributed primarily to the HIV/AIDS epidemic, the emergence of multiple-drug-resistant (MDR) strains of TB, and social factors such as immigration, poverty, homelessness, and drug abuse. Today, the number of people affected by TB in the United States continues to decline, with a total of 14,093 cases reported in 2005, the lowest number recorded since national reporting began in 1953 (CDC, 2006b). This decline can be attributed to TB-control programs that emphasize promptly identifying new cases and initiating and completing appropriate therapy.

Worldwide, TB continues to be a significant health problem, with an estimated 2 billion people (one-third of the world's population) infected by *M. tuberculosis*. An estimated 9 million cases of TB develop annually, with the vast majority (95%) occurring in developing countries of Asia, Africa, the Middle East, and Latin America. TB accounts for an estimated 2 million deaths each year (CDC, 2006c).

Today, TB in the United States is a disease primarily affecting immigrants, those infected with HIV, and disadvantaged populations. See the Focus on Cultural Diversity box on the primary populations affected by TB. Poor urban areas are hit the hardest—areas that are also affected by the epidemics of injection drug use, homelessness, malnutrition, and poor living conditions. Overcrowded institutions also contribute to the spread of TB; transmission in hospitals, homeless shelters, drug treatment centers, prisons, and residential facilities has been documented. People with altered immune function, including older adults (see the box on page 1282) and people with AIDS are at particular risk for tuberculosis. Some strains of *M. tuberculosis* have become resistant to the primary drugs used to treat the disease (isoniazid and rifampin), with the number of MDR cases of TB increased by 13.3% between 2004 and 2005 (CDC, 2006a).

FAST FACTS

- Worldwide, approximately 39% of identified *M. tuberculosis* strains are MDR, demonstrating resistance to at least isoniazid and rifampin.
- Of MDR tuberculosis strains identified worldwide, 7% are extensively drug resistant (XDR). XDR tuberculosis is resistant to isoniazid and rifampin, as well as at least three of the six main classes of second-line tuberculosis drugs (CDC, 2006a).
- The prevalence of MDR and XDR tuberculosis in the United States is lower, with 1.6% of cases reported from 1993 through 2004 identified as MDR. Of these, 4.1% were resistant to three or more classes of antituberculosis drugs, qualifying as XDR tuberculosis (CDC, 2006a).

Risk Factors

The risk for infection by *M. tuberculosis* is affected by characteristics of the infectious person, the extent of air contamination, duration of exposure, and susceptibility of the host. The number of microbes in the sputum, frequency and force of coughing, and behaviors such as covering the mouth when coughing affect the production of droplet nuclei. In a small, closed, or poorly ventilated space, droplet nuclei become more concentrated, increasing the risk of exposure. Prolonged contact, such as living in the same household, increases the risk. Less-than-optimal immune function, a problem for people in lower socioeconomic groups, injection drug users, the homeless, alcoholics, and people with HIV infection, increases the susceptibility of the host.

FOCUS ON CULTURAL DIVERSITY
Tuberculosis

- The TB case rate for foreign-born U.S. residents is 8.7 times higher than that for people born in the United States (CDC, 2006b).
- Asians and Pacific Islanders living in the United States have the highest case rates, nearly 20 times higher than that for whites.
- Case rates for blacks and Hispanics in the United States are 7 to 8 times that for whites.

Pathophysiology

Pulmonary Tuberculosis

Minute droplet nuclei containing one to three bacilli that elude upper airway defense systems to enter the lungs implant in an alveolus or respiratory bronchiole, usually in an upper lobe. As the bacteria multiply, they cause a local inflammatory response. The inflammatory response brings neutrophils and macrophages to the site. These phagocytic cells surround and engulf the bacilli, isolating them and preventing their spread. *M. tuberculosis* continues to slowly multiply; some enter the lymphatic system to stimulate a cellular-mediated immune response. (See Chapter 12 ∞ for a review of immune responses.) Neutrophils and macrophages isolate the bacteria but cannot destroy them. A granulomatous lesion called a *tubercle*, a sealed-off colony of bacilli, is formed. Within the tubercle, infected tissue dies, forming a cheeselike center, a process called *caseation necrosis*.

If the immune response is adequate, scar tissue develops around the tubercle, and the bacilli remain encapsulated. These lesions eventually calcify and are visible on x-ray. The client, while infected by *M. tuberculosis*, does not develop tuberculosis disease. If the immune response is inadequate to contain the bacilli, the disease of tuberculosis can develop. Occasionally, the infection can progress, leading to extensive destruction of lung tissue. In *primary tuberculosis*, granulomatous tissue may erode into a bronchus or into a blood vessel, allowing the disease to spread throughout the lung or other organs. This severe form of tuberculosis is uncommon in adults (Kasper et al., 2005).

A previously healed tuberculosis lesion may be reactivated. *Reactivation tuberculosis* occurs when the immune system is suppressed due to age, disease, or use of immunosuppressive drugs. The extent of lung disease can vary from small lesions to extensive cavitation of lung tissue. Tubercles rupture, spreading bacilli into the airways to form satellite lesions and produce tuberculosis pneumonia. Without treatment, massive lung involvement can lead to death, or a more chronic process of tubercle formation and cavitation may

NURSING CARE OF THE OLDER ADULT Tuberculosis

The prevalence of active tuberculosis is significantly higher among older Caucasian adults in the United States than it is in young adults (Kasper et al., 2005). Of cases among older adults, approximately 90% occur due to reactivation of a dormant bacterium. Older adults are at increased risk for reactivation tuberculosis due to age-related decreases in cell-mediated immunity. Chronic illnesses, poor nutrition, gastrectomy, alcoholism, or the long-term use of steroids and immunosuppressive agents may also reactivate dormant TB lesions.

Presenting symptoms of tuberculosis in the older adult are often vague, including coughing, weight loss, anorexia, or periodic fevers. These signs and symptoms should not be dismissed as a normal part of aging.

Residents of nursing homes are at increased risk for acquiring tuberculosis because of group living. Yearly tuberculin skin testing with purified protein derivative (PPD) is often required by state health departments. If the initial test is negative, a repeat PPD in 1 to 2 weeks is recommended. This improves sensitivity to the test so that silent cases of tuberculosis are not missed. A chest x-ray and sputum culture for acid-fast bacilli are obtained if the PPD is positive.

Successful treatment for tuberculosis includes taking at least two drugs for at least 6 to 9 months to totally eradicate the organism. Older adults usually do not develop drug-resistant forms of tuberculosis, because they acquired the disease prior to emergence of drug-resistant strains.

Assessing for Home Care

Community-dwelling older adults are susceptible to tuberculosis as well as those in care facilities. The older adult with respiratory symptoms often is treated presumptively for pneumonia, without a sputum smear and Gram stain. Older adults living in the community may not have had a tuberculin test or chest x-ray for many years.

Assess risk factors for tuberculosis:

- General health and nutritional status, including intake of specific nutrients such as vitamin D (lack of vitamin D is associated with a higher risk of developing active tuberculosis)
- Presence of a chronic disease such as silicosis, diabetes, alcoholism, or HIV infection; past history of a gastrectomy
- Past history of a positive tuberculin test that now has converted to negative
- Medications such as corticosteroids or other immunosuppressive drugs.

Assess living and social situation:

- Natural light and ventilation in the home
- Access to clean water, cooking facilities, grocery stores, and other services
- Possible exposure to infected people, for example, sharing a household with someone with active TB, crowded living facilities, homelessness, frequent participation in senior activities, volunteer work in residential care facilities or other institutional settings
- Access to health care

Tuberculosis is typically treated in the community; hospitalization or institutionalization rarely is necessary or desirable. For the older adult being treated for active TB in the community, assess:

- Knowledge and understanding of the disease and the prescribed treatment regimen
- Mental status and ability to follow prescribed regimen and precautions to avoid exposing others to the disease
- Transportation and ability to access healthcare services on a regular basis
- Financial resources to complete treatment and follow-up care
- Need for home health or social services to ensure adequate treatment.

Health Education for the Client and Family

Teaching focuses on improving the older adult's ability to self-manage the disease and treatment. Teach about tuberculosis and how it is spread. Emphasize the importance of taking all medications as prescribed and complying with follow-up appointments and testing. Discuss the importance of:

- Using disposable tissues to contain respiratory secretions, especially during the first 2 weeks of treatment when the disease may be transmitted to others
- Avoiding exposure to crowds or people with infectious diseases
- Eating a well-balanced diet with adequate nutrients
- Getting adequate rest, sleep, and exercise to maintain good general health
- Ensuring that housemates or others having frequent contact with the client are tested and receive prophylactic treatment if indicated.

Teach about possible side effects of the prescribed medications and the importance of reporting these to healthcare providers:

- Peripheral neuropathy (numbness, tingling, or a burning sensation of the extremities) may occur with isoniazid (INH). Pyridoxine (vitamin B_6) often is prescribed to prevent this adverse effect.
- Both INH and rifampin may cause hepatitis. Avoid alcohol while taking these drugs, and report any manifestations such as nausea and anorexia, jaundice, a change in urine or stool color, or pain in the upper right quadrant.
- Rifampin may cause an orange-red coloration of saliva and urine.
- Streptomycin can affect hearing and balance; promptly report any changes, because they may be irreversible.
- Ethambutol may affect red-green color discrimination and visual acuity. Use caution when driving or walking in unfamiliar areas and promptly report any vision changes.

result. People with chronic disease continue to spread *M. tuberculosis* into the environment, potentially infecting others. *Pathophysiology Illustrated: Tuberculosis* on pages 1284–1285 illustrates the pathogenesis of tuberculosis.

Clients with HIV disease are at high risk for developing active tuberculosis, due to primary infection or reactivation. HIV infection suppresses cellular immunity, which is vital to limiting the replication and spread of *M. tuberculosis*.

FAST FACTS

- The organism causing tuberculosis, *Mycobacterium tuberculosis*, is spread through droplet nuclei that remain suspended in air for several hours.
- A tubercle is a sealed-off colony of bacilli; if it ruptures, organisms spread, leading to tuberculosis pneumonia.
- Primary or secondary tuberculosis lesions may affect other body systems such as the kidneys, genitalia, bone, and brain.

MANIFESTATIONS AND COMPLICATIONS The initial infection causes few symptoms and typically goes unnoticed until the tuberculin test becomes positive or calcified lesions are seen on chest x-ray. Manifestations of primary progressive or reactivation tuberculosis often develop insidiously and are initially nonspecific (see the box below). Fatigue, weight loss, anorexia, low-grade afternoon fever, and night sweats are common. A dry cough develops, which later becomes productive of purulent and/or blood-tinged sputum. It is often at this stage that the client seeks medical attention.

Tuberculosis empyema and bronchopleural fistula are the most serious complications of pulmonary tuberculosis. When a tuberculosis lesion ruptures, bacilli may contaminate the pleural space. Rupture also may allow air to enter the pleural space from the lung, causing pneumothorax.

Extrapulmonary Tuberculosis

When primary disease or reactivation allows live bacilli to enter the bronchi, the disease may spread through the blood and lymph system to other organs. These distant disease metastases may produce an active lesion, or they may become dormant and reactivate at a later time. Extrapulmonary tuberculosis is especially prevalent in people with HIV disease.

MILIARY TUBERCULOSIS *Miliary tuberculosis* results from hematogenous spread (through the blood) of the bacilli throughout the body. Miliary tuberculosis causes chills and fever, weakness, malaise, and progressive dyspnea. Multiple lesions evenly distributed throughout the lungs are noted on x-ray. The sputum rarely contains organisms. The bone marrow is usually involved, causing anemia, thrombocytopenia, and leukocytosis. Without appropriate treatment, the prognosis is poor.

GENITOURINARY TUBERCULOSIS The kidney and genitourinary tract are common extrapulmonary sites for tuberculosis. The organism spreads to the kidney through the blood, initiating an inflammatory process similar to that which occurs in the lungs. Reactivation can occur years after the original infection. As the lesion then enlarges and caseates, a large portion of the renal parenchyma is destroyed. The infection then can spread to the rest of the urinary tract, including the ureters and bladder. Scarring and strictures commonly result. In men, the prostate, seminal vesicles, and epididymis may be involved. In women, tuberculosis may affect the fallopian tubes and ovaries.

Manifestations of genitourinary tuberculosis develop insidiously. Symptoms of a urinary tract infection, including malaise, dysuria, hematuria, and pyuria, develop. Flank pain may be present. Men may develop manifestations of epididymitis or prostatitis: perineal, sacral, or scrotal pain and tenderness; difficulty voiding; and fever. Women may have manifestations of pelvic inflammatory disease, impaired fertility, or ectopic pregnancy.

TUBERCULOSIS MENINGITIS Tuberculosis meningitis results when tuberculosis spreads to the subarachnoid space. In the United States, this complication most often affects older adults, usually from reactivation of latent disease. Manifestations develop gradually, with listlessness, irritability, anorexia, and fever. Headache and behavior changes are common early symptoms in the older adult. As the disease progresses, the headache increases in intensity, vomiting develops, and the level of consciousness decreases. Convulsions and coma may follow. Without appropriate treatment, neurologic effects may become permanent.

SKELETAL TUBERCULOSIS Tuberculosis of the bones and joints is most likely to occur during childhood, when bone epiphyses are open and their blood supply is rich. The organisms spread via the blood to vertebrae, the ends of long bones, and joints. Immune and inflammatory processes isolate the bacilli, and the disease often becomes evident years or decades later.

Tuberculous spondylitis usually involves the thoracic vertebrae, eroding vertebral bodies and causing them to collapse. Significant kyphosis develops, and the spinal cord may be compressed. The large, weight-bearing joints (hips and knees) are most often affected by tuberculous arthritis, although other joints may be affected, particularly if they have been previously damaged. The involved joint is painful, warm, and tender.

MANIFESTATIONS of Pulmonary Tuberculosis

- Fatigue
- Weight loss
- Anorexia
- Low-grade afternoon fever and night sweats
- Cough: initially dry, later productive of purulent and/or blood-tinged sputum

INTERDISCIPLINARY CARE

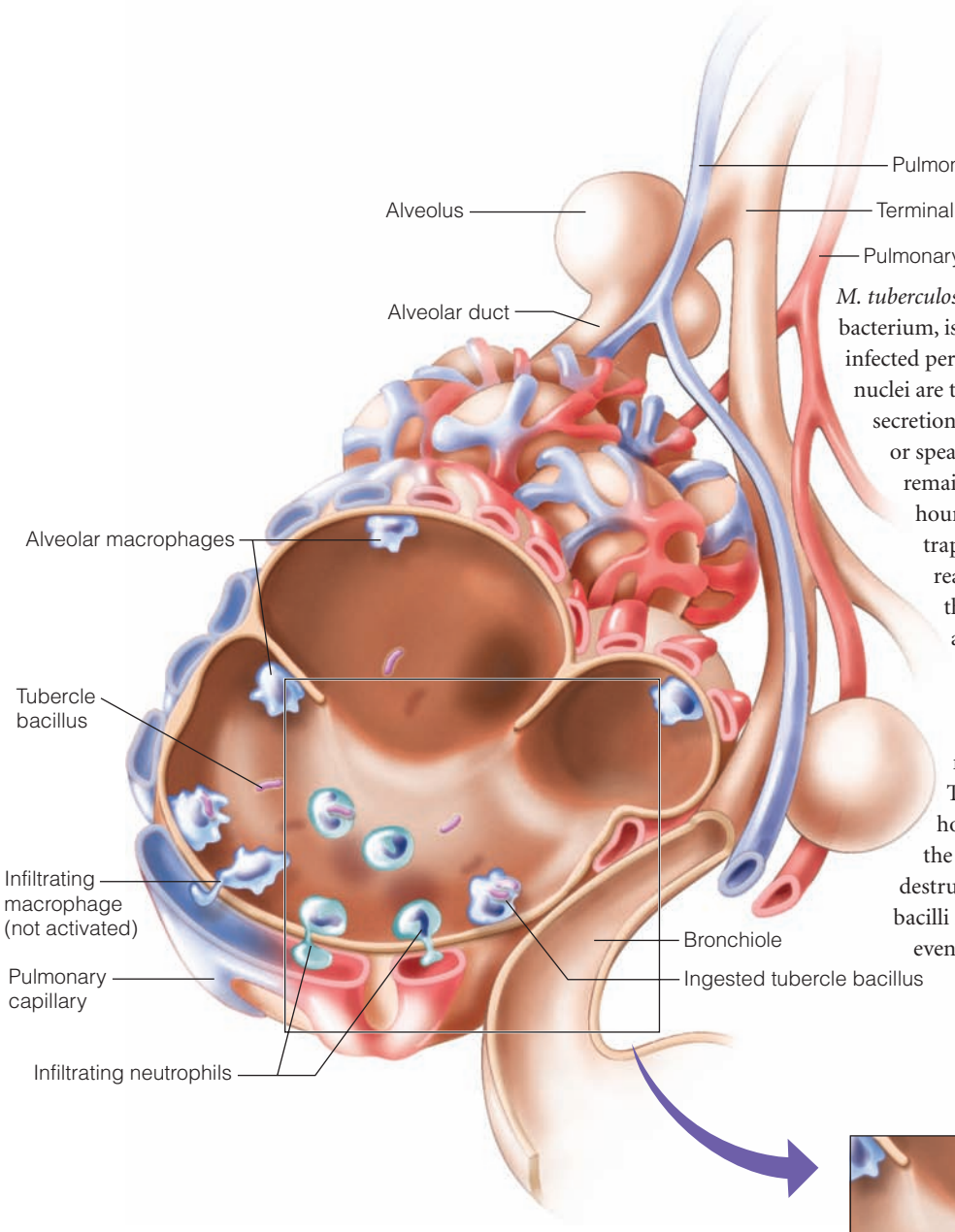
Tuberculosis was a major public health concern earlier in this century, before the development of effective sanitation measures and drug treatment. Developing drug-resistant strains, susceptibility of people with HIV disease, and inadequate access to health care for high-risk populations contribute to the continuing significance of tuberculosis as a significant public health threat. Interdisciplinary care, therefore, focuses on the following:

- Early detection
- Accurate diagnosis
- Effective disease treatment
- Preventing tuberculosis spread to others.

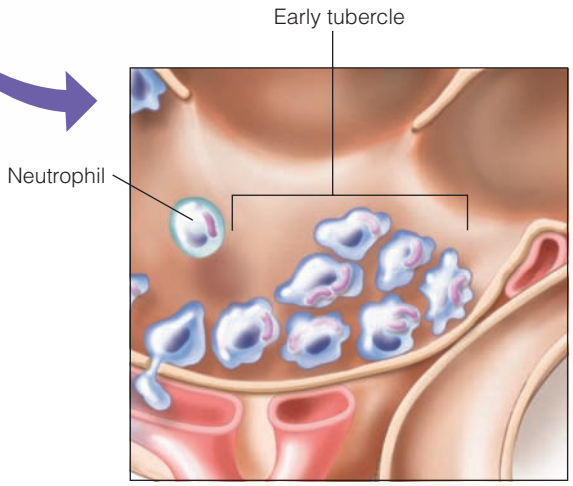
Hospitalization is rarely required to treat tuberculosis. With appropriate treatment, clients become noninfective to others fairly rapidly. However, a client with active tuberculosis may be admitted for a concurrent problem or a complication of the disease. Nurses and other healthcare workers are at risk for exposure if the disease has not yet been diagnosed. When a client

PATHOPHYSIOLOGY ILLUSTRATED

Tuberculosis

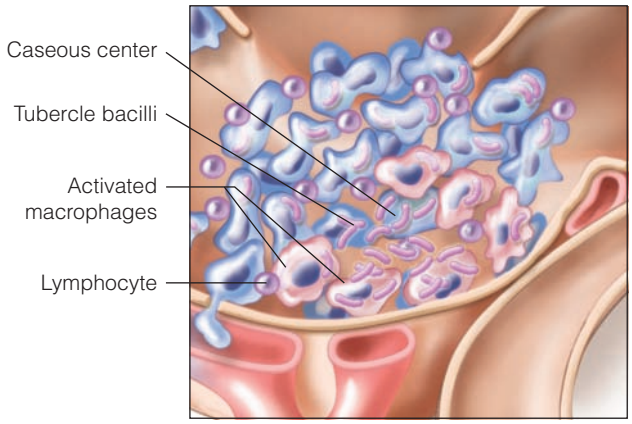


M. tuberculosis, a rod-shaped aerobic bacterium, is spread via droplet nuclei from an infected person to a susceptible host. Droplet nuclei are tiny droplets of respiratory secretions spread via coughing, sneezing, or speaking. When dried, they can remain suspended in air for several hours. Most inhaled bacilli are trapped in the upper airways; those reaching distal airways implant in the respiratory bronchioles and alveoli. Rarely, these tubercle bacilli multiply unchecked to cause primary tuberculosis. In most cases, activated alveolar macrophages ingest the bacilli. The bacilli may be destroyed; however, unique characteristics of the tuberculosis bacillus resist its destruction by the macrophage. The bacilli multiply within the macrophage, eventually killing the macrophage.



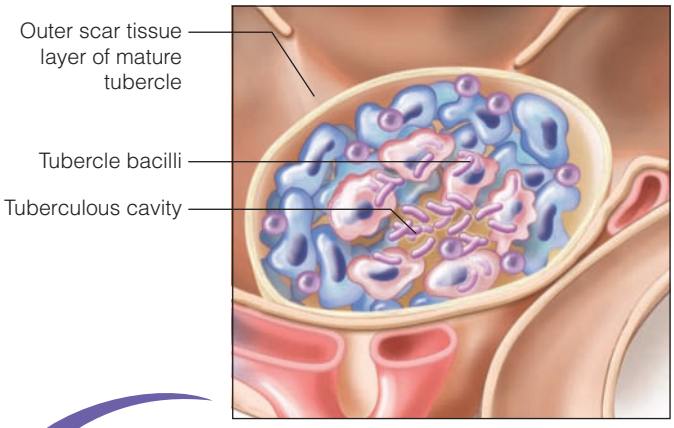
The dead macrophages lyse, releasing various chemotaxic factors into the bloodstream. Neutrophils and non-activated macrophages are attracted to the site. These phagocytic cells ingest the tubercle bacilli released from the lysed macrophages.

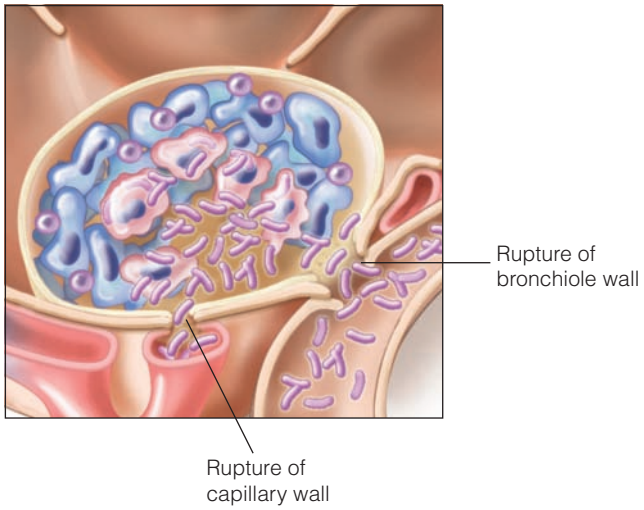
MEDIALINK Tuberculosis Animation



After several weeks, a delayed hypersensitivity response to bacterial antigens destroys many of the macrophages. Concurrently, a cell-mediated immune response activates additional macrophages, which ingest and destroy the bacilli. The lysed macrophages and bacilli are surrounded by a mass of live, activated macrophages and lymphocytes. Scar (granulomatous) tissue forms, encapsulating the primary lesion. Most lesions calcify and are visible on x-ray. These lesions may remain dormant for a year or more (in some cases, many years) before being reactivated to produce secondary or reactivation tuberculosis.

When the immune and macrophage-activating responses are weakened by age or disease (e.g., HIV disease), the tuberculosis bacilli continue to multiply within the lesion. The caseous material at the center of the lesion liquefies, and the lesion grows.





The enlarging lesion damages surrounding bronchial walls and blood vessels. Granulomatous tissue surrounding the lesion can erode into a bronchus, forming an air-filling cavity. Within this cavity, the bacilli multiply, spreading into the airways and the environment via infected sputum. Bacilli multiply, spreading into the airways and the environment via infected sputum. Bacilli also spread via the blood and within macrophages to regional lymph nodes, and from there to many organs and tissues. Resulting extrapulmonary lesions evolve in the same sequence as pulmonary lesions.

with tuberculosis is institutionalized, maintain respiratory isolation to minimize the risk of infection to other clients and to the healthcare workers.

Noncompliance with prescribed treatment is a major problem in treating active tuberculosis: The client can continue transmitting the disease to others, and drug-resistant strains of bacteria can develop when treatment is incomplete. Tuberculosis must be reported to local and state public health departments; contacts are identified and examined. People who share living or work environments with the client are tested and receive prophylactic treatment. Continuing contact with clients who have active TB is vital to ensure effective cure.

Screening

The tuberculin test is used to screen for tuberculosis infection. A cellular, or delayed hypersensitivity, response to *M. tuberculosis* develops within 3 to 10 weeks after the infection. Injecting a small amount of *purified protein derivative (PPD)* of tuberculin any time thereafter activates this response, attracting macrophages to the area and causing a pronounced local inflammatory response. The amount of induration surrounding the injection site is used to determine infection (see Table 38–5 and Figure 38–7 ■). It is important to remember that a positive response indicates that infection and a cellular (T-cell) response have developed; however, it does not mean that active disease is present or that the client is infectious to others.

Several methods are currently available for tuberculin testing:

- *Intradermal PPD (Mantoux) test:* 0.1 mL of PPD (5 tuberculin units, or TU) is injected intradermally into the dorsal aspect of the forearm. This test is read within 48 to 72 hours (the peak reaction period) and recorded as the diameter of induration (raised area, not erythema) in millimeters.
- *Multiple-puncture (tine) test:* A multiple-puncture device is used to introduce tuberculin into the skin. This test is less accurate than other testing methods. A vesicular reaction is considered positive; any other reaction must be confirmed using a Mantoux test.

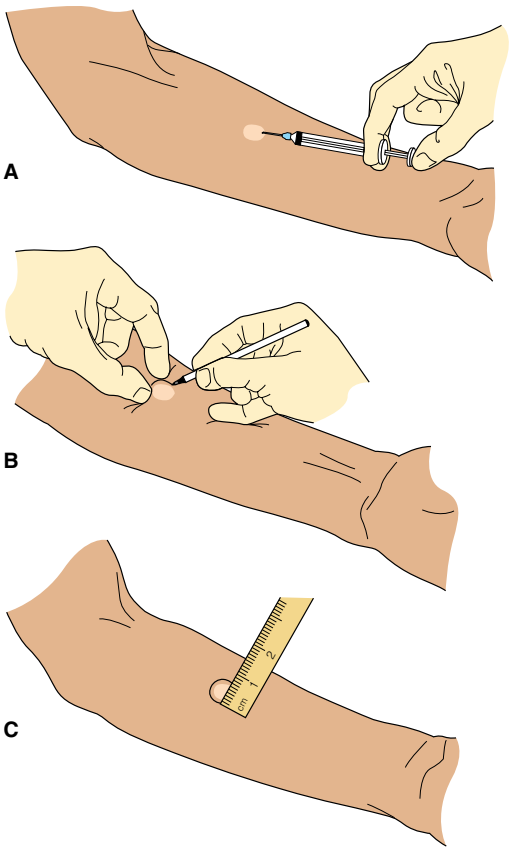


Figure 38–7 ■ *A,* Intradermal injection for tuberculin testing. *B,* The injection causes a local inflammatory response (wheal). *C,* Measurement of induration following tuberculin testing.

Although it is impractical and unnecessary to screen the entire population, the CDC recommend screening people in the following risk groups:

- People with or at high risk for HIV infection
- Close contacts of people who have or are suspected of having infectious TB

TABLE 38–5 **Interpreting Tuberculin Test Results**

AREA OF INDURATION	SIGNIFICANCE
Less than 5 mm	Negative response; does not rule out infection.
5 to 9 mm	Positive for people who: ■ Are in close contact with a client with infective TB. ■ Have an abnormal chest x-ray. ■ Have HIV infection or are immunocompromised. ■ Have an organ transplant. Negative for all others.
10 to 15 mm	Positive for people who have other risk factors: ■ Birth in a high-incidence country. ■ African American, Hispanic, Asian American in poverty areas. ■ Injection drug use. ■ Residence in a long-term care facility, correctional institution, residential care setting, homeless shelter. ■ Medical risk factors (e.g., malnutrition, diabetes, others).
Greater than 15 mm	Positive for all people.

- People with medical risk factors, such as silicosis, chronic malabsorption, end-stage renal failure, diabetes mellitus, immunosuppression, and hematologic and other malignancies
- People born in countries with a high prevalence of TB
- Medically underserved low-income populations, including racial and ethnic minorities
- Alcoholics and injection drug users
- Residents and staff of long-term residential facilities, such as long-term care facilities, correctional institutions, and mental health facilities.

False-negative responses are common in people who are immunosuppressed. A two-step procedure may be necessary to elicit a positive response. If the first test elicits a negative response, a second PPD test is given 1 week later. If the second test also is negative, the client either is free of infection or is *anergic* (unable to react to common antigens). This two-step procedure is recommended for long-term care residents and workers.

Diagnosis

A positive tuberculin test alone does not indicate active disease. Sputum tests for the bacillus and chest x-rays are routinely used to diagnose and evaluate active disease. A series of three consecutive early morning sputum specimens is typically examined for bacilli (see Procedure 36–1). Use special procedures or personal protective devices when obtaining sputum specimens. If possible, collect specimens in a room equipped with airflow control devices, ultraviolet light, or both. Alternatively, have the client step outside to collect the specimen. Wear a mask capable of filtering droplet nuclei when collecting sputum specimens. Aerosol therapy, percussion, and postural drainage may help the client produce sputum. Occasionally, endotracheal suctioning, bronchoscopy, or gastric lavage may be necessary to obtain a specimen. See the Diagnostic Tests box in Chapter 36 ∞ for nursing care related to bronchoscopy.

- *Sputum smear* is microscopically examined for *acid-fast bacilli. M. tuberculosis* resists decolorizing chemicals after staining. This property is called *acid fast*. The acid-fast smear provides a rapid indicator of the tubercle bacillus.
- *Sputum culture* positive for *M. tuberculosis* provides the definitive diagnosis. However, *M. tuberculosis* is slow growing, requiring 4 to 8 weeks before it can be detected using traditional culture techniques. Automated radiometric culture systems (such as Bactec) allow detection of *M. tuberculosis* in several days.
- Once the organism is detected, *sensitivity testing* is performed to identify appropriate drug therapy.
- *Polymerase chain reaction (PCR)* permits rapid detection of DNA from *M. tuberculosis*.
- *Chest x-ray* is ordered to diagnose and evaluate TB. Typical findings in pulmonary TB include dense lesions in the apical and posterior segments of the upper lobe and possible cavity formation.

Prior to initiating antituberculosis drug therapy, several additional diagnostic tests may be done to establish baseline data for monitoring potential adverse effects of the drugs.

- *Liver function tests* are obtained prior to treatment with isoniazid (INH) because this drug is hepatotoxic.
- A thorough *vision examination* is done prior to treatment with ethambutol, a commonly used antituberculosis medication. Optic neuritis is a potential adverse effect of this drug. Periodic eye examinations are scheduled during the course of therapy.
- *Audiometric testing* is performed before streptomycin therapy is initiated. Ototoxicity is a significant adverse effect of streptomycin and other aminoglycoside antibiotics. Hearing also is evaluated periodically during the course of therapy to detect any hearing loss.

Medications

Chemotherapeutic medications are used both to prevent and treat tuberculosis infection. Goals of the pharmacologic treatment of TB are to:

- Make the disease noncommunicable to others.
- Reduce symptoms of the disease.
- Effect a cure in the shortest possible time.

Prophylactic treatment is used to prevent active tuberculosis. Clients with a recent skin test conversion from negative to positive are often started on prophylactic therapy, especially when other risk factors are present. Prophylactic therapy also is used for people in close household contact with a person whose sputum is positive for bacilli. Single-drug therapy is effective for prophylactic treatment, whereas treatment of active disease always involves two or more chemotherapeutic medications. For adults, INH, 300 mg per day for a period of 6 to 12 months, is commonly used to prevent active TB.

When INH prophylaxis is contraindicated, bacilli Calmette-Guérin (BCG) vaccine may be prescribed. This vaccine is widely used in developing countries. BCG is made from an attenuated strain of *M. bovis*, a closely related bacillus that causes tuberculosis in cattle. In the United States, BCG vaccine is recommended only for infants, children, and healthcare workers with a negative tuberculin test who are repeatedly exposed to untreated or ineffectively treated people with active disease. After vaccination with BCG, a positive reaction to tuberculin testing is common. Periodic chest x-rays may be required for screening purposes.

The tuberculosis bacillus mutates readily to drug-resistant forms when only one anti-infective agent is used. Active disease is always treated with concurrent use of at least two antibacterial medications to which the organism is sensitive. The primary antituberculosis drugs can prevent development of resistance because all act by different mechanisms. However, the organism is protected within the tubercle, and 6 or more months of treatment is necessary to eradicate it.

Newly diagnosed tuberculosis is typically treated with an initial regimen of four oral antitubercular drugs, isoniazid, rifampin, and pyrazinamide, and ethambutol daily (or several times per week on a decreasing schedule of frequency) for the first 2 months of treatment. This initial regimen is followed by at least 4 additional months of therapy with isoniazid and rifampin, given daily, twice per week, or weekly. In the presence of HIV infection, treatment is continued for at least 9 months. The most common antituberculosis drugs are outlined in Table 38–6; their nursing implications are outlined in the Medication Administration box on pages 1288–1289.

TABLE 38–6 **Antituberculosis Medications**

DRUG AND DOSAGE	ADVERSE EFFECTS	NURSING IMPLICATIONS
Isoniazid (INH), oral: 300 mg daily or 900 mg one, two, or three times weekly	Peripheral neuropathy Hepatitis	Administer pyridoxine (vitamin B_6) concurrently. Monitor liver function studies (AST and ALT); avoid other hepatotoxins.
Rifampin (RMP), oral: 600 mg daily or two or three times weekly	Hepatitis Flulike syndrome; fever	As for INH. Do not miss or skip doses; flulike syndrome and fever occur when drug is resumed.
	Colors body fluids—including sweat, urine, saliva, tears, and cerebrospinal fluid (CSF)—orange-red	Contact lenses may become discolored and should not be worn.
Pyrazinamide (PZA), oral: 1 to 2 g daily; or 2 to 4 g twice weekly	Hyperuricemia Hepatotoxicity	Monitor uric acid levels. Monitor AST and ALT; avoid other hepatotoxins.
Ethambutol (EMB), oral: 800 mg to 1600 mg daily; or 2 to 4 g twice weekly	Optic neuritis	Monitor red-green color discrimination and visual acuity.
Streptomycin (SM), intramuscular: 15 mg/kg, up to 1 g daily; or 25 to 30 mg/kg twice weekly	Ototoxicity, vertigo Nephrotoxicity	Have periodic audiometric examinations conducted. Monitor renal function studies, including BUN and serum creatinine.

If a drug-resistant strain is suspected, therapy is tailored to the resistance. In some cases, four or more anti-infective drugs may be used.

Antitubercular medications have many adverse and toxic effects. Close monitoring during therapy is necessary. Most have some degree of, or risk for, hepatotoxicity. For this reason, clients should avoid using alcohol and other drugs (such as acetaminophen) or chemicals that can damage the liver. Baseline liver and renal function studies are done prior to initiating therapy. Audiometric testing also may be done before treatment is started, because several commonly used medications can affect hearing. Regular visits to a healthcare provider are necessary to evaluate regularly for adverse effects. Although none of these drugs have been proved to be teratogenic, potential adverse effects on the fetus are weighed against the benefit to the mother before they are prescribed during pregnancy.

Compliance with the prescribed regimen also is evaluated during follow-up visits. The urine can be examined for color changes characteristic of rifampin and tested for metabolites of INH. When compliance is a problem, medications are administered under direct supervision. Twice-weekly therapy is more cost effective in this instance, with a public health nurse watching the client take and swallow the prescribed medication.

MEDICATION ADMINISTRATION Antituberculosis Drugs

ISONIAZID (INH, LANIAZID, NYDRAZID)

Isoniazid is the drug of choice for tuberculosis prophylaxis and a first-line drug for treating active disease. It is effective against both intracellular and extracellular organisms. Isoniazid is used alone as a prophylactic medication and in combination with rifampin, ethambutol, or both. A fixed-dose combination form with 150 mg of INH and 300 mg of rifampin (Rifamate) is available as well.

Nursing Responsibilities

- Administer on an empty stomach 1 hour before or 2 hours after meals for maximal effect if tolerated; may be given with meals to reduce gastrointestinal effects.
- Monitor for adverse effects:
  a. Numbness and tingling of the extremities (most likely to occur in malnourished, alcoholic, or diabetic clients)
  b. Hepatotoxicity, as evidenced by abnormal liver function studies and scleral jaundice
  c. Hypersensitivity reactions, such as rash, drug fever, or evidence of anemia, bruising, bleeding, or infection related to agranulocytosis.
- Isoniazid interferes with the metabolism of diazepam (Valium), phenytoin (Dilantin), and carbamazepine. Doses of these drugs may need to be reduced to prevent toxicity.

Health Education for the Client and Family

- Take the medication as prescribed for the entire treatment period to prevent incomplete eradication of the bacteria and development of resistant strains.
- Take the medication on an empty stomach. If nausea and vomiting occur, take with meals.
- If anorexia, nausea, vomiting, and jaundice (yellowing of the skin and the whites of the eyes) develop, notify your doctor immediately.
- Take pyridoxine as prescribed to prevent peripheral neuropathy.
- Avoid alcohol and other agents that may be harmful to the liver.
- Notify your doctor if you develop signs of an allergic reaction, such as rash, fever, easy bruising, bleeding gums, or fatigue.

MEDICATION ADMINISTRATION **Antituberculosis Drugs (continued)**

- Use measures to prevent pregnancy while taking INH; this drug may be harmful to the developing fetus.

RIFAMPIN (RIFADIN, RIMACTANE)

Rifampin is commonly used in combination with INH and other antitubercular drugs. It is relatively low in toxicity, although it can cause hepatitis, a flulike immune response, and, rarely, renal failure. Rifampin stimulates the microsomal enzymes of the liver, increasing the rate of metabolism of many drugs and decreasing their effectiveness.

Nursing Responsibilities

- Administer on an empty stomach.
- Monitor CBC, liver function studies, and renal function studies for evidence of toxicity.
- Rifampin reduces the effect of oral contraceptives, quinidine, corticosteroids, warfarin, methadone, digoxin, and hypoglycemics. Monitor for the effectiveness of these drugs.

Health Education for the Client and Family

- Rifampin causes body fluids, including sweat, urine, saliva, and tears, to turn red-orange. This is not harmful. Avoid wearing soft contact lenses because they may be permanently stained.
- Aspirin may interfere with rifampin absorption and should not be taken concurrently.
- Fever, flulike symptoms, excessive fatigue, sore throat, or unusual bleeding may indicate an adverse reaction to the drug and should be reported to your doctor.

PYRAZINAMIDE (TEBRAZID)

Pyrazinamide typically is given with INH and rifampin for the first 2 months of tuberculosis treatment. Concurrent use of pyrazinamide allows a shorter course of therapy. As with many of the antitubercular agents, pyrazinamide is toxic to the liver. Its other principal adverse effect is hyperuricemia. Gout, however, rarely develops.

Nursing Responsibilities

- Administer with meals to reduce gastrointestinal side effects.
- Monitor liver function studies and serum uric acid levels. Notify the physician if changes are noted.

Health Education for the Client and Family

- Notify your doctor if you develop loss of appetite, nausea, vomiting, jaundice, or symptoms of gout (a painful, red, hot, swollen joint, often the great toe or elbow).
- While taking this drug, avoid using alcohol or other substances that may be harmful to the liver.

ETHAMBUTOL (MYAMBUTOL)

Ethambutol is added to the initial treatment regimen or substituted for INH when an INH-resistant strain of TB is suspected. Ethambutol is a bacteriostatic drug that reduces the development of resistance to the bactericidal first-line agents. Its principal toxic effect is optic neuritis; fortunately, this is reversible. Early signs of optic neuritis include decreased visual acuity and loss of red-green discrimination. This drug may be safe for use in pregnancy.

Nursing Responsibilities

- Record a baseline visual examination prior to therapy. Schedule periodic eye exams during the course of treatment.
- Administer with meals to reduce gastrointestinal side effects.
- Monitor liver and renal function studies and neurologic status while taking this drug. Notify the physician of abnormal findings or significant changes.

Health Education for the Client and Family

- Monitor vision daily by reading newspapers and looking at the same blue object (using usual corrective lenses, if appropriate). Notify your doctor if changes in vision or color perception occur.

STREPTOMYCIN

An aminoglycoside antibiotic, streptomycin is highly effective in treating most mycobacterial infection. Resistance may develop if it is used alone. There are two primary drawbacks to streptomycin: (1) It must be administered parenterally because it is not absorbed in the gastrointestinal tract, and (2) it has toxic effects on the kidneys and ears.

Nursing Responsibilities

- Administer by deep intramuscular injection into a large muscle mass, rotating sites to minimize tissue trauma.
- Monitor urine output, weight, and renal function studies (including BUN and serum creatinine) to detect early signs of nephrotoxicity. Report significant changes to the physician.
- Maintain fluid intake at 2000 to 3000 mL per day to minimize the concentration of drug in the kidney tubules.
- Assess hearing and balance frequently. Have audiometric testing performed as indicated.

Health Education for the Client and Family

- Maintain a daily fluid intake of at least 2.5 to 3 quarts.
- Weigh yourself on the same scale at least twice a week; report any significant weight gain to your doctor.
- Notify your doctor if hearing acuity decreases, ringing or buzzing sensations in the ear develop, or dizziness occurs.

Repeat sputum specimens and chest x-rays are used to evaluate the effectiveness of therapy. In most cases, sputum cultures for *M. tuberculosis* are negative within 2 months of therapy; virtually all clients have negative sputum cultures within 3 months. If cultures remain positive at 3 months and beyond, treatment failure and drug resistance are suspected. In this case, cultures of the organism are tested for susceptibility to antitubercular agents, and two or three previously unused drugs are added to the treatment regimen (Kasper et al., 2005).

With adherence to prescribed treatment, virtually all clients should have negative sputum cultures for *M. tuberculosis* within 3 months. The relapse rate for current treatment regimens is less than 5%. The principal cause of treatment failure is noncompliance (Tierney et al., 2005).

NURSING CARE

Health Promotion

Tuberculosis today presents a greater threat to public health than it does to individuals. Nurses play a key role in maintaining public health. Education and tuberculosis screening

MEDIALINK Case Study: TB Medication Compliance

are major nursing strategies to prevent TB. See the accompanying Nursing Research box regarding tuberculosis screening for a homeless population.

Public health teaching includes increasing awareness of tuberculosis as a reemerging threat. Teach clients in all settings how to reduce the spread of TB by covering their mouths when coughing or sneezing and disposing of sputum appropriately. The benefit of screening programs to identify infected (though not necessarily infective) people also needs to be included in public health education.

The best tuberculosis prevention is early diagnosis of infections and appropriate treatment to achieve cure. BCG vaccine is recommended for infants born in countries where tuberculosis is prevalent, but is not widely used in the United States. It may be administered to healthcare workers in settings where the risk of infection with MDR strains of *M. tuberculosis* is high despite rigorous infection control measures (Kasper et al., 2005).

The primary preventive strategy used in the United States is treating people with latent tuberculosis infection demonstrated by a positive tuberculin test. A 9- to 10-month course of treatment with isoniazid reduces the risk of active TB by 90% or more (Kasper et al., 2005). Isoniazid also is prescribed prophylactically for people with HIV infection who have been exposed to TB.

ASSESSMENT

Focused assessment for the client with suspected TB includes the following:

- *Health history:* Complaints of fatigue, weight loss, night sweats, difficulty breathing, cough (productive or nonproductive), bloody sputum, or chest pain; known exposure to TB; most recent tuberculin test and results; living circumstances; alcohol and other recreational drug use.
- *Physical examination:* Vital signs including temperature; general appearance; respiratory rate and lung sounds.
- *Diagnostic tests:* Tuberculin test results, presence of acid-fast bacilli in sputum, chest x-ray.

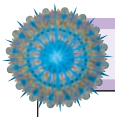
Nursing Diagnoses and Interventions

Nursing care related to tuberculosis focuses primarily on infection control and compliance with prescribed treatment. See the accompanying Nursing Care Plan on the next page.

Deficient Knowledge

Adequate knowledge and information are necessary to manage the disease and prevent its transmission to others. The client needs to understand reasons for prolonged drug therapy and the importance of complying with treatment and follow-up. Antituberculosis drugs are relatively toxic. The client needs to know how to minimize toxicity.

- Assess knowledge about the disease process; identify misperceptions and emotional reactions. *Teaching based on previous learning enhances understanding and retention of information.*
- Assess ability and interest in learning, developmental level, and obstacles to learning. *Assessment allows presentation of information in a manner tailored to the learning needs and style of the client, promoting learning.*



NURSING RESEARCH **Evidence-Based Practice: Clients with Risk for Tuberculosis**

Homeless people and those living in homeless shelters have several identified risk factors for TB: high incidence of drug and alcohol abuse, lowered immune status, and crowded living conditions. Access to and participation in TB screening, however, often is problematic. Swigart and Kolb (2004) identified factors contributing to homeless persons' decisions to participate in free TB screening. Contrary to the beliefs of many healthcare providers, many homeless people chose to participate in the screening out of a desire to maintain good health and a recognition that homelessness and shelter life increased their risk of developing TB. The desire to maintain good health was particularly noted as a reason among those participants in early recovery from drug or alcohol addiction. Other major factors cited for participating included a history of lung problems, a desire to identify possible problems related to smoking, and encouragement by shelter personnel. Fear of the results and a desire "not to be bothered" had negative effects on participation. Women with children were least likely to participate in screening in this study, citing fear of being identified as ill that could result in loss of child custody.

IMPLICATIONS FOR NURSING

Outreach to homeless populations for health services, while difficult, has personal and public health benefits. The homeless often lack access to preventive and health promotion services, instead interacting with healthcare providers only intermittently when urgent care is needed. This study suggests, however, that a portion of this population desires to maintain good health and is receptive when screening and health promotion services are accessible. Shelter personnel were instrumental in getting many of the study participants to the screening. Recruiting the support of these workers can improve resident participation. Regularly scheduling a nurse in a shelter can allow trust to develop and can also improve participation in health promotion activities. This may be a particularly important strategy in shelters for women with children—bringing services to the residents to reduce the fear of being perceived as unable to care for dependent children.

CRITICAL THINKING IN CLIENT CARE

1. What factors contribute to the perception of many healthcare providers that homeless people and shelter residents do not care about maintaining good health?
2. The participants in this study were screened for their ability to understand English and to read or hear and comprehend the interview and process. How might the healthcare team need to alter its approach to reach homeless people who have mental illnesses that affect thinking and cognition?
3. Design a TB screening program using a multidisciplinary team to reach a specific population. Identify members of the team and discuss your rationale for their inclusion on the team.

NURSING CARE PLAN A Client with Tuberculosis

Harry Facée, age 53, arrives at a metropolitan public health clinic complaining of aching chest pain that has lasted for the past few days. He says that his sputum also is bloody. He is afraid he might have lung cancer, so he came in to see a doctor.

ASSESSMENT

Raj Kamil, RN, the public health nurse at the clinic, obtains an admission history and physical examination of Mr. Facée. Mr. Kamil notes that Mr. Facée is a homeless person who has lived on the streets and in various shelters for the past "10 years or so." He usually prefers to sleep outdoors, taking refuge in shelters only during very cold or very wet weather. He has a small disability income, but usually scrounges for food or eats with other homeless people at soup kitchens. Mr. Facée states that he has had a cough for a long time, which has become worse recently. It is now productive, especially in the mornings. He also admits that he has recently been waking up drenched with sweat in the middle of the night and is more tired than usual.

Although Mr. Facée's clothes are tattered, he is fairly clean. He answers questions appropriately and intelligently. Mr. Kamil does not detect any odor of alcohol on his breath. He is very thin, almost emaciated. Mr. Facée's vital signs are BP 152/86, P 92, R 20, and T 100.2°F (37.8°C).

Suspecting tuberculosis, Mr. Kamil obtains a sputum specimen for Gram stain and culture, administers a tuberculin test, and sends Mr. Facée for a chest x-ray before he sees the clinic physician. Although the chest x-ray is inconclusive, the Gram stain is positive for acid-fast bacilli. The diagnosis of probable active pulmonary tuberculosis is made. The physician prescribes isoniazid, 300 mg orally; rifampin, 600 mg orally; and pyrazinamide, 1500 mg orally daily for 2 months, to be followed by twice weekly isoniazid 900 mg orally and rifampin 600 mg orally. The physician also orders weekly sputum cultures for the first month.

DIAGNOSES

- *Ineffective Health Maintenance* related to homelessness
- *Risk for Noncompliance with Prescribed Treatment* related to lack of understanding and resources
- *Imbalanced Nutrition: Less than Body Requirements* related to increased metabolic needs associated with infection
- *Risk for Disturbed Sensory Perception: Kinesthetic* related to effects of isoniazid therapy

EXPECTED OUTCOMES

- Keep all follow-up appointments as scheduled.
- Verbalize an understanding of his disease and its treatment.
- Follow the prescribed plan of care.
- Demonstrate measures to prevent spread of the organism to others.
- Gain 1 to 2 lb of weight per week.
- Promptly report symptoms of peripheral neuropathy, including numbness, tingling, or burning sensations.

PLANNING AND IMPLEMENTATION

- Teach about tuberculosis, and provide a client education pamphlet about the disease.
- Instruct about the prescribed medications, potential adverse effects, and the importance of completing the entire prescribed regimen.
- Emphasize the importance of continued follow-up.
- Teach and demonstrate sputum and droplet control measures.
- Escort to the local incentive shelter program for directly observed medical therapy and meals.
- Identify verbally and in writing manifestations to report to the physician.

EVALUATION

Mr. Kamil successfully enrolls Mr. Facée in the local incentive shelter program. In this program, a healthcare worker administers Mr. Facée's medications daily, watching him swallow them. He is assigned a small individual room and can eat three daily meals at the shelter. He still prefers to sleep outside when the weather permits, but he complies with the requirement for supervised medication administration because he "likes the food there." Always a clean person, Mr. Facée is able to demonstrate appropriate sputum control measures and practices them faithfully. The sputum culture done after 2 months of treatment is negative for tubercle bacilli, and his chest x-ray indicates no disease progression.

CRITICAL THINKING IN THE NURSING PROCESS

1. Many homeless people have schizophrenia or other mental diseases. How would you adapt the care plan for a homeless schizophrenic client with active tuberculosis?
2. Mr. Kamil was fortunate in having access to an incentive shelter with healthcare workers to supervise medication compliance. Identify available resources in your area for homeless clients infected with tuberculosis.
3. Develop a care plan for the nursing diagnosis *Ineffective Airway Clearance* related to mucopurulent sputum and weak cough.

See Evaluating Your Response in Appendix C.

- Identify support systems, and include significant others in teaching. *A knowledgeable significant other provides reinforcement of learning, confirmation of understanding, and encouragement for the client. Including significant others also reduces the risk of inadvertent sabotage of the treatment plan.*
- Establish a relationship of mutual trust with the client and significant others. *An atmosphere of trust increases receptiveness to teaching and learning.*
- Develop mutually acceptable learning goals with the client and significant other. *Working together to identify learning needs and establish goals increases the client's "ownership" and interest in the process.*
- Select appropriate teaching strategies, using learning aids such as literature and visual materials that are appropriate for age, level of education, and intellect. *Teaching tailored to the client is more effective and results in better learning.*
- Teach about tuberculosis and the prescribed treatment, including:
  a. Nature of the disease and its spread
  b. Purpose of treatment and follow-up procedures

c. Measures to prevent spreading the disease to others
d. Importance of maintaining good general health by eating a well-balanced, high-protein, high-carbohydrate diet; balancing exercise with rest; and avoiding crowds and people with upper respiratory infections
e. Names, doses, purposes, and adverse effects of prescribed medications
f. Importance of avoiding alcohol and other substances that may damage the liver while taking chemotherapeutic drugs
g. Fluid intake needs of 2.5 to 3.0 quarts of fluid per day
h. Manifestations to report to the physician: chest pain, hemoptysis, difficulty breathing; anorexia, nausea, or vomiting; yellow tint to skin or sclera; sudden weight gain, swollen feet, ankles, legs, or hands; hearing loss, tinnitus, or vertigo; change in vision or difficulty discriminating colors.

Tuberculosis is a chronic disease requiring lengthy treatment with antitubercular medications. A good understanding of the disease, its treatment, and potential adverse effects of therapy prepares the client to manage care.

- Document teaching and level of understanding. Reinforce teaching and learning as needed. *Teaching is not complete until the client can demonstrate learning of the information.*

Ineffective Therapeutic Regimen Management

The populations at highest risk for developing active tuberculosis—the homeless and members of lower socioeconomic groups—are also at high risk for being unable to manage its complex treatment regimen. Three or more costly medications that may have unpleasant or even dangerous side effects are prescribed. Frequent medical follow-up is required. Infectious diseases such as TB carry a stigma that may lead to denial of the disease or its seriousness. Alcoholics and IV drug users need to withdraw from their addiction to be successful in treating the disease. The client with HIV infection faces a potentially fatal disease and costly treatment that may well override concerns about tuberculosis management.

- Assess self-care abilities and support systems. *Assessment is used to help determine the client's ability to follow the prescribed regimen.*
- Assess knowledge and understanding of the disease, its complications, treatment, and risks to others. Provide additional teaching and reinforcement as indicated. *Lack of understanding is a barrier to compliance with and management of the treatment regimen.*
- Work collaboratively to identify barriers or obstacles to managing the prescribed treatment. *Working collaboratively with the client and other members of the healthcare team provides insight for overcoming identified barriers to effective treatment.*
- Assist the client, significant others (if available), and healthcare team members to develop a plan for managing the prescribed regimen. *Including the client in developing a plan to manage care increases the sense of control and ownership and helps ensure that personal, cultural, and lifestyle factors are considered. This increases the likelihood of compliance.*
- Provide verbal and written instructions that are clear and appropriate for level of literacy, knowledge, and understanding. *Clearly written directions provide support and reinforcement for the client.*
- Provide active intervention for homeless people, including shelter placement or other housing and ongoing follow-up by easily accessed healthcare providers (clinics and public health workers in the neighborhood that do not present transportation or access problems, either real or perceived). *Simple referral will not ensure compliance, especially among disenfranchised populations. Active intervention is needed to help ensure treatment compliance.*
- Refer clients who are unlikely to comply with the treatment regimen to the public health department for management and follow-up. *Because tuberculosis presents a significant public health risk, public health follow-up is essential. In some cases, it is necessary for nurses to administer medications, observing the client swallow all pills.*

Risk for Infection

The spread of tuberculosis is a risk in any facility housing many people. It is especially high in residential care facilities for older clients and for people with AIDS. The increasing incidence of TB among homeless people and members of lower socioeconomic groups increases the risk in hospitals, emergency departments, and public and urgent care clinics. Respiratory precautions are necessary to prevent the spread of TB via microscopic airborne droplets to other clients and to healthcare workers.

- Place the client in a private room with airflow control that prevents air within the room from circulating into the hallway or other rooms. A negative flow room in which air is diluted by at least six fresh-air exchanges per hour is recommended. *A negative flow room and multiple fresh-air exchanges dilute the concentration of droplet nuclei within the room and prevent their spread to adjacent areas.*
- Use standard precautions and tuberculosis isolation techniques as recommended by the CDC, including wearing masks and gowns when caring for clients who do not reliably cover the mouth when coughing. *These measures are important to prevent the spread of tuberculosis to others.*

PRACTICE ALERT

Use personal protective devices to reduce the risk of transmission during client care. The Occupational Safety and Health Administration (OSHA) requires use of a HEPA-filtered respirator for protection against occupational exposure to tuberculosis. Surgical masks are ineffective to filter droplet nuclei, necessitating the use of protective devices capable of filtering bacteria and particles smaller than 1 micron.

- Discuss the reasons for and importance of respiratory isolation procedures during initial hospitalization. When treatment is provided as an outpatient, instruct to avoid crowds and close physical contact and maintain ventilation in living facilities, particularly during the first 3 weeks of treatment. *These measures help protect others during initial treatment, when sputum is still likely to contain significant numbers of bacilli.*

- Place a mask on the client when transporting to other parts of the facility for diagnostic or treatment procedures. *Covering the client's nose and mouth during transport minimizes air contamination and the risk to visitors and personnel.*
- Inform all personnel having contact with the client of the diagnosis. *This allows personnel to take appropriate precautions.*
- Assist visitors to mask prior to entering the room. *Providing visitors with appropriate masks or respirators reduces their risk of infection.*
- Teach the client how to limit transmitting the disease to others:
  a. Always cough and expectorate into tissues.
  b. Dispose of tissues properly, placing them in a closed bag.
  c. Wear a mask if you are sneezing or unable to control respiratory secretions.
  d. The disease is not spread by touching inanimate objects, so no special precautions are required for eating utensils, clothing, books, or other objects used.

  Teaching appropriate precautions helps prevent the spread of tuberculosis to others while allowing as much freedom from restraints as possible.
- Teach how to collect sputum specimens. If necessary, have the client step outside to collect a sputum specimen. *This minimizes the risk of exposure to healthcare personnel and provides for rapid dilution of any droplet nuclei produced and their exposure to ultraviolet light (which kills the bacteria).*
- Teach the importance of complying with the prescribed treatment for the entire course of therapy. *Completion of the entire treatment regimen is important to reduce the risk of relapse and creation of drug-resistant organisms.*

Using NANDA, NIC, and NOC

Linkages between NANDA nursing diagnoses, nursing interventions, and nursing outcomes for the client with tuberculosis are illustrated in Chart 38–2.

NANDA, NIC, AND NOC LINKAGES
CHART 38–2 **The Client with Tuberculosis**

NANDA

Ineffective Therapeutic Regimen Management

↓

NIC

Health System Guidance

Patient Contracting

Self-Responsibility Facilitation

Teaching: Prescribed Medication

↓

NOC

Knowledge: Health Resources

Compliance Behavior

Treatment Behavior: Illness or Injury

Knowledge: Medication

Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC) (3rd ed.)* by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

Community-Based Care

Most clients with TB are managed in community settings; few require institutionalization. In addition to the teaching topics and strategies identified above, discuss the following topics when preparing the client and significant others for home care:

- Importance of screening close contacts for infection and possibly prophylactic treatment
- Effect, dose, and timing for all medications, and potential side effects and their management
- Importance of long-term therapy in eradicating the disease
- Principles of good nutrition, dietary guidelines for a client with TB, and other measures to help maintain good health, such as balancing rest with exercise
- Signs and symptoms of complications to report to the physician or healthcare provider.

Provide referrals as appropriate:

- Smoking cessation clinics or support groups
- Alcohol treatment facilities, Alcoholics Anonymous, other treatment programs or support groups
- Drug treatment facilities, Narcotics Anonymous, other outpatient or inpatient treatment programs or support groups
- Low-cost community clinics and incentive programs for people with TB
- Counseling, support groups, and other community resources that provide additional assistance and support.

THE CLIENT WITH INHALATION ANTHRAX

Inhalation anthrax is a relatively new potential threat in the United States. This disease rarely affects humans in nature, even though both wild and domestic animals can be infected. However, *Bacillus anthracis*, the spore-forming rod responsible for causing anthrax, has been identified as an agent likely to be used as a biologic weapon. Anthrax spores can be aerosolized so they remain suspended in the air, allowing them to be inhaled into the lungs. Person-to-person transmission does not occur.

Inhalation anthrax causes initial flulike symptoms, including malaise, dry cough, and fever. This is followed by an abrupt onset of severe dyspnea, stridor, and cyanosis. Lymph nodes in the mediastinum and thorax become inflamed and enlarged. Septic shock and/or meningitis may develop. Untreated, death results from hemorrhagic thoracic lymphadenitis and hemorrhagic mediastinitis with resultant hypotension and hypoxemia (Kasper et al., 2005).

Blood cultures and chest x-ray are used to diagnose inhalation anthrax. However, because death can quickly result from the disease, people who are known or suspected to have been exposed to anthrax spores often are treated prophylactically. Ciprofloxacin (Cipro) is used to both prevent and treat inhalation anthrax. Doxycycline (Vibramycin) is an alternative to ciprofloxacin. Although an anthrax vaccine exists, its use at this time is considered experimental (Persell et al., 2002). See the section on bioterrorism in Chapter 7 ∞ for more information about anthrax and the section in Chapter 39 ∞ on respiratory failure for nursing care measures for the client with inhalation anthrax.

THE CLIENT WITH A FUNGAL INFECTION

Fungal spores are endemic, present in the air everyone breathes. Normal respiratory defense mechanisms allow few of these spores to reach the lungs. If they reach the lungs, pulmonary macrophages and neutrophils efficiently remove them in most people. When they do cause infection, it is typically mild and self-limiting. Most fungi are opportunistic, able to cause infection only in people who are immunocompromised. For this reason, clients with AIDS, renal failure, leukemia, burns, or chronic diseases, as well as people receiving corticosteroids or immunosuppressants, are particularly susceptible to fungal diseases.

Many fungal lung diseases have a geographic distribution pattern. Histoplasmosis and blastomycosis are more common in the southeastern, mid-Atlantic, and central states. California, Arizona, and western Texas are the primary sites for coccidioidomycosis, also known as San Joaquin valley fever (Kasper et al., 2005).

The course and manifestations of fungal lung diseases resemble those of tuberculosis. Lung lesions are slow to develop, and symptoms are mild. The fungus can disseminate from the lung to other organs.

Pathophysiology

Histoplasmosis

Histoplasmosis, an infectious disease caused by *Histoplasma capsulatum*, is the most common fungal lung infection in the United States. The organism is found in the soil and is linked to exposure to bird droppings and bats. Infection occurs when the spores are inhaled and reach the alveoli. Most infections develop into *latent asymptomatic disease*, much like tuberculosis, or *primary acute histoplasmosis*, a mild, self-limiting influenza-like illness. Initial chest x-rays are nonspecific; later ones show areas of calcification. *Chronic progressive disease*, usually seen in older adults, typically is limited to the lung but may involve any organ. Progressive lung changes and cavitation occur, with increasing dyspnea and eventual disabling pulmonary disease.

Regional lymph vessels spread the organism from the lungs to other parts of the body, much like the process that occurs in tuberculosis. In the healthy host, normal immune responses inactivate and remove the organism. In the immunocompromised host, however, macrophages remove the fungi but are unable to destroy them, resulting in *disseminated histoplasmosis*. This type of histoplasmosis is often fatal. Manifestations of fever, dyspnea, cough, weight loss, and muscle wasting are usual. Ulcerations of the mouth and oropharynx may be present, and the liver and spleen are enlarged.

Coccidioidomycosis

Coccidioidomycosis is an infectious disease caused by the fungus *Coccidioides immitis*. This mold grows in the soil of the arid Southwest, Mexico, and Central and South America. When inhaled, the fungus typically causes an acute, self-limiting pulmonary infection that often is asymptomatic and goes unrecognized. If manifestations do occur, they resemble those of influenza, with malaise, fever, body aches, and cough. Pleuritic pain, skin rash, and arthritis of the knees and ankles also may develop. Disseminated disease, which may affect the lymph nodes, meninges, spleen, liver, kidney, skin, and adrenal glands, is rare in immunocompetent people. When it does occur, the mortality rate is high. Meningitis is the usual cause of death.

Blastomycosis

The fungus *Blastomyces dermatitidis* causes the infectious disease blastomycosis. It occurs primarily in the south central and midwestern regions of the United States and in Canada. Men are affected more frequently than women. The lungs are the primary site for the disease, although it may spread to involve the skin, bones, genitourinary system, and, rarely, the CNS. Pulmonary symptoms include fever, dyspnea, pleuritic chest pain, and cough, which may become productive of bloody or purulent sputum. If untreated, the disseminated disease is slowly progressive and ultimately fatal.

Aspergillosis

Aspergillus spores are common in the environment, but rarely cause disease except in the immunocompromised. When they do cause infection, *Aspergillus* species invade blood vessels and produce hyphae that branch at acute angles, frequently causing venous or arterial thrombosis. In the lungs, aspergillosis can cause an acute, diffuse, self-limited pneumonitis. The manifestations of pulmonary aspergillosis include dyspnea, nonproductive cough, pleuritic chest pain, chills, and fever. If the organism invades a pulmonary blood vessel, hemoptysis or massive pulmonary hemorrhage can occur. In clients with underlying lung disease, balls of *Aspergillus* hyphae may form within cysts or cavities, usually in the upper lobes of the lung. When this occurs, symptoms often are milder and more insidious in onset, with fever, weight loss, night sweats, and cough (Kasper et al., 2005).

INTERDISCIPLINARY CARE

Most fungal lung infections can be diagnosed by microscopic examination of a sputum specimen for the fungus. (See Chapter 36 ∞ for nursing responsibilities related to collecting a sputum specimen.) Blood cultures also may be done, as well as cultures of cerebrospinal fluid if indicated. Chest x-ray may show typical changes in lung tissue or widening of the mediastinum, depending on the infecting organism.

Acute pulmonary histoplasmosis and acute pulmonary coccidioidomycosis usually resolve without treatment, although antifungal drugs may be given to shorten the disease course.

Oral itraconazole (Sporanox), a broad-spectrum antifungal agent, is commonly prescribed to treat histoplasmosis. Other fungal lung diseases and clients who are immunocompromised are often treated with intravenous amphotericin B. Surgery (lobectomy) may be indicated for clients with severe hemoptysis associated with aspergillosis.

NURSING CARE

Clients with fungal lung infections have different nursing care needs, depending on the disease and their immune status. For most clients, nursing care focuses on education. People living in high-prevalence areas or who have specific risk factors such as exposure to bird droppings (for example, by cleaning chicken coops, pigeon lofts, or barns where birds roost), decomposed vegetation, rotting wood, or stored grain need to be aware of the risk, common symptoms, and measures to reduce the risk. Clients with latent histoplasmosis may need education to maintain good general health to prevent reactivation. Teach clients receiving antifungal drugs about the specific drug, its intended and adverse effects, the duration of therapy, and symptoms to report to the physician. Include teaching about any specific precautions such as drug or food interactions. Itraconazole interacts with many medications; verify the safety of concurrent usage with all other prescribed drugs. Its use is contraindicated during pregnancy and lactation; emphasize the importance of effective birth control and of notifying the physician immediately if pregnancy occurs. Amphotericin B is a toxic drug. Administer the initial intravenous dose slowly after premedicating with an antihistamine and antiemetic as ordered to manage its adverse effects. Monitor carefully during infusion and therapy for changes in vital signs, hydration, nutrition, weight, or urine output.

DISORDERS OF THE PLEURA

The *pleura* is a thin membrane with two layers: the visceral pleura, which overlies the lung surface, and the parietal pleura, which lines the inner chest wall. Between the layers of pleura is a potential space, the *pleural cavity*, which contains a thin layer of serous fluid. As the thoracic cavity expands during inspiration, the pressure in this space becomes negative in relation to atmospheric and alveolar pressure. The expansible lung is drawn out, and air rushes into the alveoli. When the pleura is inflamed or affected by disease or injury, air or fluid can collect in the pleural cavity, restricting lung expansion, air movement, and ventilation.

THE CLIENT WITH PLEURITIS

Pleuritis (*pleurisy*), inflammation of the pleura, irritates sensory fibers of the parietal pleura, causing characteristic pain. Pleural inflammation usually occurs secondarily to another process, such as a viral respiratory illness, pneumonia, or rib injury.

The onset of pleuritis is typically abrupt. The pain is unilateral and well localized; it is usually sharp or stabbing in nature. Pain may be referred to the neck or the shoulder. Deep breathing, coughing, and movement aggravate the pain. Respirations are rapid and shallow, and chest wall movement is limited on the affected side. Breath sounds are diminished, and a pleural friction rub may be heard over the site.

The diagnosis of pleuritis is based on its manifestations. Chest x-ray and ECG may be ordered to rule out other causes of chest pain. Treatment for pleuritis is symptomatic. Analgesics and nonsteroidal anti-inflammatory drugs (NSAIDs), indomethacin (Indocin) in particular, help relieve the pain. Codeine may be ordered, both to relieve pain and to suppress the cough.

Nursing care for the client with pleuritis is directed toward promoting comfort, including administration of NSAIDs and analgesics. Positioning and splinting the chest while coughing also are helpful. Although wrapping the chest with 6-inch-wide elastic bandages may help relieve pain, this may excessively restrict chest motion, increasing the risk of impaired airway clearance.

Teach the client and family that pleuritis is generally self-limited and of short duration. Discuss symptoms to report to the physician: increased fever, productive cough, difficulty breathing, or shortness of breath. Provide information about prescription and nonprescription NSAIDs and analgesics, including the drug ordered, how to use it, and its desired and possible adverse effects.

THE CLIENT WITH A PLEURAL EFFUSION

The pleural space normally contains only about 10 to 20 mL of serous fluid. **Pleural effusion** is collection of excess fluid in the pleural space. Pleural effusions result from either systemic or local disease. Systemic disorders that may lead to pleural effusion include heart failure, liver or renal disease, and connective tissue disorders, such as rheumatoid arthritis and systemic lupus erythematosus (SLE). Pneumonia, atelectasis, tuberculosis, lung cancer, and trauma are local conditions that may cause pleural effusion.

Pathophysiology and Manifestations

Excess pleural fluid may be either *transudate*, formed when capillary pressure is high or plasma proteins are low, or *exudate*, the result of increased capillary permeability. Heart failure is the most common precipitating factor in transudate formation; it also may accompany renal failure, nephrosis, liver failure, and malignancy. Exudate, a protein-rich fluid, is seen with inflammatory processes such as infections, systemic inflammation (e.g. rheumatoid arthritis or SLE), pulmonary infarction (leading to tissue necrosis and an inflammatory response), and malignancy (Porth, 2005). Other pleural fluid collections include *empyema*, pus in the pleural cavity; *hemothorax*, the presence of blood in the cavity; *hemorrhagic pleural effusion*, a mixture of blood and pleural fluid; and *chylothorax*, a collection of lymph in the pleural space. In adults, chylothorax may result from thoracic surgery or placement of a central catheter in one of the great veins (Porth, 2005).

A large pleural effusion compresses adjacent lung tissue. This causes the characteristic manifestation of dyspnea. Pain may develop, although with inflammatory processes pleuritic

pain often is relieved by formation of an effusion, as the fluid reduces friction between inflamed visceral and parietal pleura. Breath sounds are diminished or absent, and a dull percussion tone is heard over the affected area. Chest wall movement may be limited.

INTERDISCIPLINARY CARE

Chest x-ray often provides the first evidence of a pleural effusion. Because fluid typically collects in dependent regions, it is seen at the base of the affected lung on an upright chest x-ray, and along the lateral wall when the client is positioned on the affected side. CT scans and ultrasonography also are used to localize and differentiate pleural effusions.

Thoracentesis

If the cause of pleural effusion is not apparent, a thoracentesis is done. **Thoracentesis** is an invasive procedure in which fluid (or occasionally air) is removed from the pleural space with a needle. Aspirated fluid is analyzed for appearance, cell counts, protein and glucose content, the presence of enzymes such as LDH and amylase, abnormal cells, and culture.

When pleural effusion is significant and interferes with respirations, thoracentesis is the treatment of choice to remove the fluid (Figure 38–8 ■). Thoracentesis may be performed at the bedside, in a procedure room, or in an outpatient setting. Local anesthesia is used, and the procedure requires less than 30 minutes to complete. Percussion, auscultation, radiography, or ultrasonography are used to locate the effusion and needle insertion site. The amount of fluid removed is limited to 1200 to 1500 mL at one time to reduce the risk of cardiovascular collapse from rapid removal of too much fluid. Pneumothorax is a possible complication of thoracentesis if the visceral pleura is punctured or a closed drainage system is not maintained during the procedure. Nursing care for the client undergoing a thoracentesis is outlined in the box on the next page.

Treatments

Because pleural effusion usually occurs secondarily to another disease or disorder, medical management also focuses on treating the underlying condition to prevent further fluid accumulation. An empyema may require repeated drainage, as well as high doses of parenteral antibiotics. Occasionally, thoracotomy and surgical excision may be necessary. See the box on page 1313 for nursing care of the client undergoing thoracic surgery. Recurrent pleural effusions, often due to cancer, may be prevented by instilling an irritant, such as doxycycline bleomycin, or talc, into the pleural space to cause adhesion of the parietal and visceral pleura (*pleurodesis*). Water-seal chest tube drainage is often employed for hemothorax.

NURSING CARE

Nursing care for the client with a pleural effusion is directed toward supporting respiratory function and assisting with procedures to evacuate collected fluid. With a large pleural effusion and partial lung collapse, impaired gas exchange and activity intolerance are high-priority nursing problems. Risk for impaired gas exchange is also a priority problem during the initial period following thoracentesis.

Teaching for home care focuses on symptoms of recurrent effusion or complications following a thoracentesis to report to the physician: increasing dyspnea or shortness of breath, cough, and hemoptysis. Pleuritic pain may be an early sign of effusion and also should be reported. Further teaching about an underlying condition also may be necessary; for example, the client with heart failure may need teaching about a salt-restricted diet.

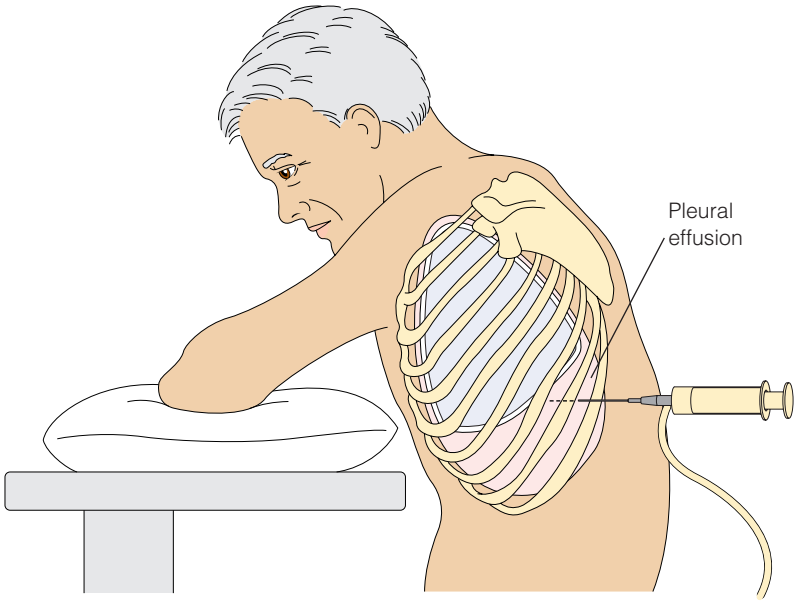


Figure 38–8 ■ Thoracentesis. With the client seated, a needle is inserted between the ribs into the pleural space to withdraw accumulated fluid.

NURSING CARE OF THE CLIENT HAVING A Thoracentesis

BEFORE THE PROCEDURE

- Verify a signed informed consent for the procedure. *This invasive procedure requires informed consent.*
- Assess knowledge and understanding of the procedure and its purpose; provide additional information as needed. *An informed client will be less apprehensive and more able to cooperate during the thoracentesis.*
- Preprocedure fasting or sedation is not required. *Only local anesthesia is used in this procedure, and the gag and cough reflexes remain intact.*
- Administer a cough suppressant if indicated. *Movement and coughing during the procedure may cause inadvertent damage to the lung or pleura.*
- Obtain a thoracentesis tray, sterile gloves, injectable lidocaine, povidone-iodine, dressing supplies, and an extra overbed table or Mayo stand. *These supplies are used by the physician performing the procedure.*
- Position the client upright, leaning forward with arms and head supported on an anchored overbed table. *This position spreads the ribs, enlarging the intercostal space for needle insertion.*
- Inform the client that although local anesthesia prevents pain as the needle is inserted, a sensation of pressure may be felt. *A pressure sensation occurs as the needle punctures the parietal pleura to enter the pleural space.*

AFTER THE PROCEDURE

- Monitor pulse, color, oxygen saturation, and other signs during thoracentesis. *These are indicators of physiologic tolerance of the procedure.*
- Apply a dressing over the puncture site, and position on the unaffected side for 1 hour. *This allows the pleural puncture to heal.*
- Label obtained specimen with name, date, source, and diagnosis; send specimen to the laboratory for analysis. *Fluid obtained during thoracentesis may be examined for abnormal cells, bacteria, and other substances to determine the cause of the pleural effusion.*
- During the first several hours after thoracentesis, frequently assess and document vital signs; oxygen saturation; respiratory status, including respiratory excursion, lung sounds, cough, or hemoptysis; and puncture site for bleeding or crepitus. *Frequent assessment is important to detect possible complications of thoracentesis, such as pneumothorax.*
- Obtain a chest x-ray. *Chest x-ray is ordered to detect possible pneumothorax.*
- Normal activities generally can be resumed after 1 hour if no evidence of pneumothorax or other complication is present. *The puncture wound of thoracentesis heals rapidly.*

THE CLIENT WITH PNEUMOTHORAX

Accumulation of air in the pleural space is called **pneumothorax**. Pneumothorax can occur spontaneously, without apparent cause, as a complication of preexisting lung disease, as a result of blunt or penetrating trauma to the chest, or from an iatrogenic cause (e.g., following thoracentesis).

Pathophysiology

Pressure in the pleural space is normally negative in relation to atmospheric pressure. This negative pressure is vital to the process of breathing. Contraction of the diaphragm and the intercostal muscles enlarges the thoracic space. Negative intrapleural pressure draws the lung outward, increasing its volume so air rushes in to fill the expanded lung space.

When either the visceral or parietal pleura is breached, air enters the pleural space, equalizing this pressure. Lung expansion is impaired, and the natural recoil tendency of the lung causes it to collapse to a greater or lesser extent, depending on the size and rapidity of air accumulation. Table 38–7 illustrates the classifications of pneumothorax.

Spontaneous Pneumothorax

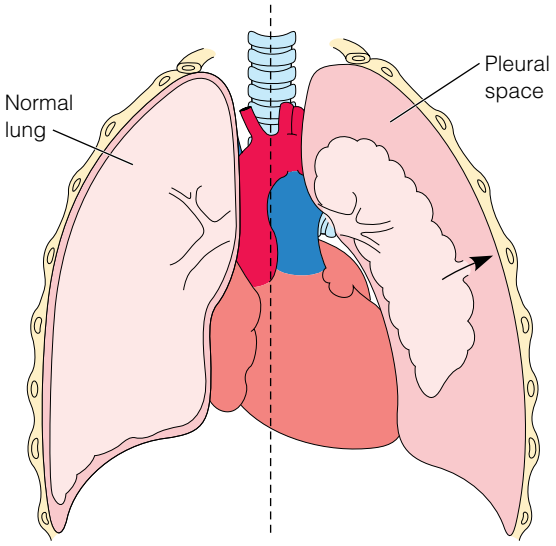
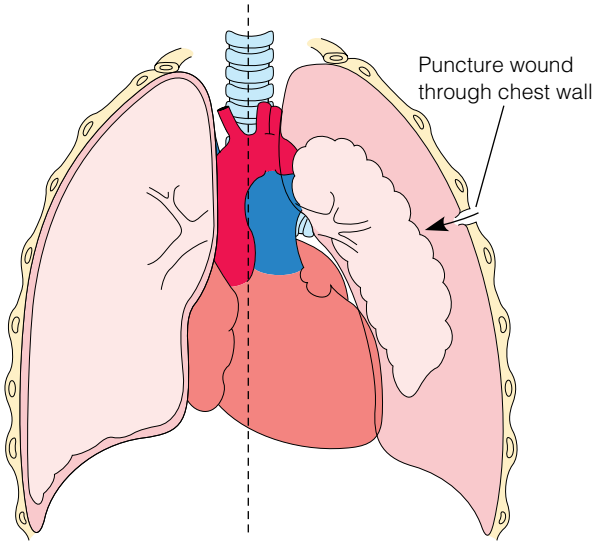
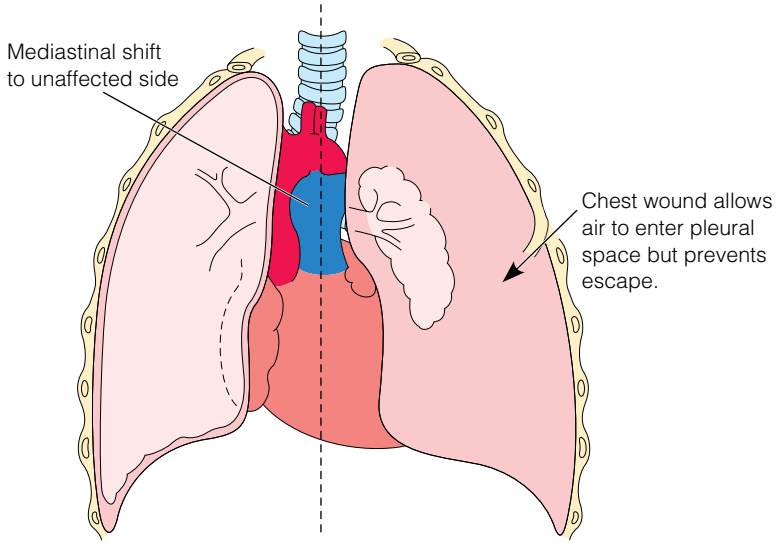
Spontaneous pneumothorax develops when an air-filled bleb, or blister, on the lung surface ruptures. Rupture allows air from the airways to enter the pleural space. Air accumulates until pressures are equalized or until collapse of the involved lung section seals the leak. Spontaneous pneumothorax may be either *primary* (*simple*) or *secondary* (*complicated*).

Primary pneumothorax affects previously healthy people, usually tall, slender men between ages 16 and 24 (Way & Doherty, 2003). The cause of primary pneumothorax is unknown. Risk factors include smoking and familial factors. Air-filled blebs tend to form in the apices of the lungs. This is considered to be a benign condition, although recurrences are common. Certain activities also increase the risk of spontaneous pneumothorax, such as high-altitude flying and rapid decompression during scuba diving.

Secondary pneumothorax, generally caused by overdistention and rupture of an alveolus, is more serious and potentially life threatening. It develops in clients with underlying lung disease, usually COPD. Middle-age and older adults are primarily affected. Secondary pneumothorax also may be associated with asthma, cystic fibrosis, pulmonary fibrosis, tuberculosis, acute respiratory distress syndrome (ARDS), and other lung diseases. Rarely, a form of secondary pneumothorax called *catamenial pneumothorax* can develop in affected women within 24 to 48 hours of the onset of menstrual flow.

MANIFESTATIONS The manifestations of spontaneous pneumothorax depend on the size of pneumothorax, extent of lung collapse, and any underlying lung disease. Typically, pleuritic chest pain and shortness of breath begin abruptly, often while at rest. The respiratory and heart rates increase as gas exchange is affected. Chest wall movement may be asymmetrical, with less movement on the affected side than the unaffected side. The affected side is hyperresonant to percussion, and breath sounds may be diminished or absent. Hypoxemia may develop, although normal mechanisms that shunt

TABLE 38–7 **Types of Pneumothorax**

TYPE	PATHOPHYSIOLOGY	MANIFESTATIONS
A. Spontaneous  	Rupture of a bleb on the lung surface allows air to enter pleural space from airways. ■ *Primary pneumothorax* affects previously healthy people. ■ *Secondary pneumothorax* affects people with preexisting lung disease (e.g., COPD).	■ Abrupt onset ■ Pleuritic chest pain ■ Dyspnea, shortness of breath ■ Tachypnea, tachycardia ■ Unequal lung excursion ■ Decreased breath sounds and hyperresonant percussion tone on affected side
B. Traumatic  	Trauma to the chest wall or pleura disrupts the pleural membrane. ■ *Open* occurs with penetrating chest trauma that allows air from the environment to enter the pleural space. ■ *Closed* occurs with blunt trauma that allows air from the lung to enter the pleural space. ■ *Iatrogenic* involves laceration of visceral pleura during a procedure such as thoracentesis or central-line insertion.	■ Pain ■ Dyspnea ■ Tachypnea, tachycardia ■ Decreased respiratory excursion ■ Absent breath sounds in affected area ■ Air movement through an open wound
C. Tension  	Air enters pleural space through chest wall or from airways but is unable to escape, resulting in rapid accumulation. Lung on affected side collapses. As intrapleural pressure increases, heart, great vessels, trachea, and esophagus shift toward the unaffected side.	■ Hypotension, shock ■ Distended neck veins ■ Severe dyspnea ■ Tachypnea, tachycardia ■ Decreased respiratory excursion ■ Absent breath sounds on affected side ■ Tracheal deviation toward unaffected side

blood flow to the unaffected lung often maintain normal oxygen saturation levels. Hypoxemia is more pronounced in secondary pneumothorax.

Traumatic Pneumothorax

Blunt or penetrating trauma of the chest wall and pleura can cause pneumothorax. Blunt trauma, for example, due to a motor vehicle crash, fall, or during cardiopulmonary resuscitation (CPR), can lead to a *closed pneumothorax*. Fractured ribs penetrating the pleura are the leading cause of pneumothorax due to blunt trauma (Yamamoto et al., 2005). Fracture of the trachea and a ruptured bronchus or esophagus also may result from blunt trauma, leading to closed pneumothorax.

Open pneumothorax (*sucking chest wound*) results from penetrating chest trauma such as a stab wound, gunshot wound, or impalement injury. With open pneumothorax, air moves freely between the pleural space and the atmosphere through the wound. Pressure on the affected side equalizes with the atmosphere, and the lung collapses rapidly. The result is significant hypoventilation.

Iatrogenic pneumothorax may result from puncture or laceration of the visceral pleura during central-line placement, thoracentesis, or lung biopsy. During bronchoscopy, bronchi or lung tissue can be disrupted. Alveoli can become overdistended and rupture during anesthesia, resuscitation procedures, or mechanical ventilation.

MANIFESTATIONS With traumatic pneumothorax, manifestations of pain and dyspnea may be masked or missed due to other injuries. Tachypnea and tachycardia may be attributed to the primary injury. Focused assessment for evidence of pneumothorax is vital. Chest wall movement on the affected side is diminished, and breath sounds are absent. If a penetrating wound is present, air may be heard and felt moving through it with respiratory efforts. Hemothorax frequently accompanies traumatic pneumothorax. The manifestations of iatrogenic pneumothorax are similar to those of spontaneous pneumothorax.

Tension Pneumothorax

Tension pneumothorax develops when injury to the chest wall or lungs allows air to enter the pleural space but prevents it from escaping. Pressure within the pleural space becomes positive in relation to atmospheric pressure as air rapidly accumulates with each breath. The lung on the affected side collapses, and pressure on the mediastinum shifts thoracic organs to the unaffected side of the chest, placing pressure on the opposite lung as well. Ventilation is severely compromised, and venous return to the heart is impaired. Tension pneumothorax is a medical emergency requiring immediate intervention to preserve respiration and cardiac output.

MANIFESTATIONS In addition to manifestations of pneumothorax, hypotension and distended neck veins are evident as venous return and cardiac output are affected. The trachea is displaced toward the unaffected side as a result of the mediastinal shift. Signs of shock may be present. See Chapter 11 ∞ for the manifestations and treatment of shock.

INTERDISCIPLINARY CARE

Treatment for pneumothorax depends on the severity of the problem. A small simple pneumothorax may require no treatment other than monitoring with serial x-rays. Air is absorbed from the pleural space, allowing most small pneumothoraces to resolve spontaneously. A large pneumothorax with significant symptoms usually requires treatment with *thoracostomy*, or the placement of chest tubes. Surgical intervention may be necessary to prevent recurrent spontaneous pneumothorax.

Diagnosis

Oxygen saturation measurements are obtained to evaluate the effect of pneumothorax on gas exchange. ABGs may be obtained to further assess gas exchange.

The chest x-ray is an effective diagnostic tool for pneumothorax. In tension pneumothorax, air is evident on the affected side, and mediastinal structures are shifted toward the opposite or unaffected side.

Treatments

CHEST TUBES The treatment of choice for significant pneumothorax is placement of a closed-chest catheter to allow the lung to reexpand. When a tube is placed in the pleural cavity to remove air or fluid, it must be sealed to prevent air from also entering the tube and, in essence, creating an open pneumothorax. Chest tubes are sealed with a Heimlich (one-way) valve (Figure 38–9 ■) or connected to a closed drainage system with a "water seal." The valve or water seal prevents air from entering the chest cavity during inspiration and allows air to escape during expiration. Applying a low level of suction to the system helps to reestablish negative pressure in the pleural space, allowing the lung to reexpand.

A number of closed-drainage chest tube systems are available. Most are self-contained disposable systems (Figure 38–10 ■). Drainage from the chest tube is collected in the first collection chamber. This sealed chamber is connected to a water seal chamber, which is in turn connected to the suction control chamber. Nursing care of the client with chest tubes is discussed in the box on page 1300.

A large-bore needle or plastic intravenous catheter may be inserted through the chest wall as emergency treatment of a tension pneumothorax. This allows air to escape from the affected side, relieving pressure on mediastinal structures and the opposite lung.

PLEURODESIS Although controversial, *pleurodesis*, or creation of adhesions between the parietal and visceral pleura, may be used to prevent recurrent pneumothorax. This procedure involves instilling a chemical agent such as doxycycline into the

Figure 38–9 ■ The Heimlich one-way valve allows air to escape from the pleural space, helping to reestablish negative pressure and allowing the lung to reexpand.

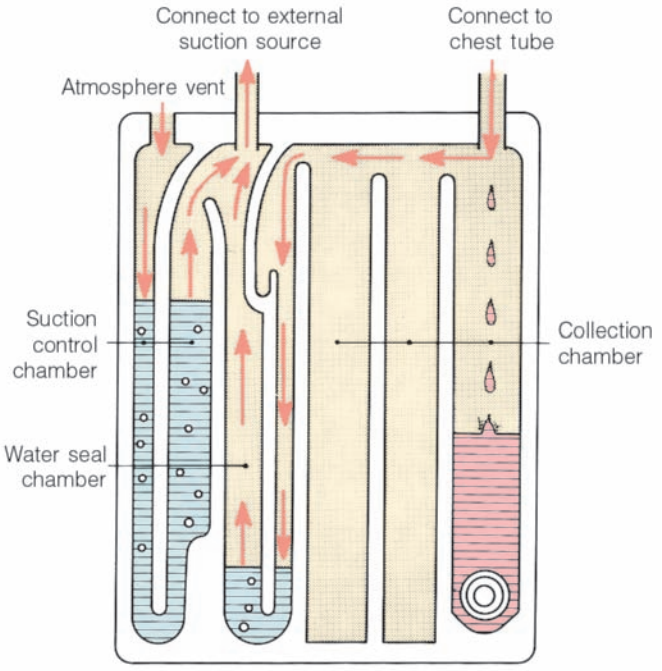


Figure 38–10 ■ A closed-chest drainage system.

pleural space. The subsequent inflammatory response creates scar tissue and adhesions between the pleural layers. This procedure reduces the recurrence rate to as low as 2% but can make subsequent surgery more difficult (Way & Doherty, 2003).

Surgery

The risk for recurrence of spontaneous pneumothorax increases with each attack. Clients at high risk for recurrent pneumothorax may have surgery to reduce the risk of future ruptures. A thoracotomy is done to excise or oversew blebs (usually at the apices of the lungs). The overlying pleura is then roughened or irritated to induce scarring and adhesion to the surface of the lung. In some cases, the parietal pleura may be partially excised. These procedures can be done using video-assisted thoracoscopic surgery (VATS), a minimally invasive surgical technique (Way & Doherty, 2003).

NURSING CARE

Health Promotion

Health promotion activities to prevent spontaneous and traumatic pneumothorax primarily involve health teaching. Initiate

NURSING CARE OF THE CLIENT WITH **Chest Tubes**

BEFORE THE PROCEDURE

- Ensure a signed informed consent for chest tube insertion. *This invasive procedure requires informed consent.*
- Provide additional information as indicated. Explain that local anesthesia will be used but that pressure may be felt as the trocar is inserted. Reassure that breathing will be easier once the chest tube is in place and the lung reexpands. *The client may be extremely dyspneic and anxious and may need reassurance that this invasive procedure will provide relief.*
- Gather all needed supplies, including thoracostomy tray, injectable lidocaine, sterile gloves, chest tube drainage system, sterile water, and a large sterile catheter-tipped syringe to use as a funnel for filling water seal and suction chambers. *These supplies are used during the insertion procedure to establish a water seal drainage system.*
- Position as indicated for the procedure. *Either an upright position (as for thoracentesis) or side-lying position may be used, depending on the site of the pneumothorax.*
- Assist with chest tube insertion as needed. The procedure may be performed in a procedure room, in the surgical suite, or at the bedside. *Although chest tube insertion is a relatively simple procedure, nursing assistance is necessary to support the client and rapidly establish a closed drainage system.*

AFTER THE PROCEDURE

- Assess respiratory status at least every 4 hours. *Frequent assessment is necessary to monitor respiratory status and the effect of the chest tube.*
- Maintain a closed system. Tape all connections, and secure the chest tube to the chest wall. *These measures are important to prevent inadvertent tube removal or disruption of system integrity.*
- Keep the collection apparatus below the level of the chest. *Pleural fluid drains into the collection apparatus by gravity flow.*
- Check tubes frequently for kinks or loops. *These could interfere with drainage.*
- Check the water seal frequently. The water level should fluctuate with respiratory effort. If it does not, the system may not be patent or intact. Periodic air bubbles in the water seal chamber are normal and indicate that trapped air is being removed from the chest. *Frequent assessment of the system is important to ensure appropriate functioning.*
- Measure drainage every 8 hours, marking the level on the drainage chamber. Report drainage that is cloudy, in excess of 70 mL per hour, or red, warm, and free flowing. *Red, free-flowing drainage indicates hemorrhage; cloudiness may indicate an infection. Emptying the drainage would disrupt integrity of the closed system.*
- Periodically assess water level in the suction control chamber, adding water as necessary. *Adequate water in the suction control chamber prevents excess suction from being placed on delicate pleural tissue.*
- Assist with frequent position changes and sitting and ambulation as allowed. *Chest tubes should not prevent performance of allowed activities. Care is needed to prevent inadvertent disconnection or removal of the tubes.*
- When the chest tube is removed, immediately apply a sterile occlusive petroleum jelly dressing. *An occlusive dressing prevents air from reentering the pleural space through the chest wound.*

and participate in programs to prevent smoking among children and teenagers. Teach safe behaviors such as always wearing a seat beat in an automobile, driving safely, and using precautions to prevent falls when working or recreating in high places.

Assessment

The client with pneumothorax may be in acute respiratory distress, necessitating rapid and focused assessment.

- *Health History:* Current symptoms and their duration; precipitating factors or activities if known; previous episodes of pneumothorax; smoking history; chronic pulmonary diseases such as COPD.
- *Physical Assessment:* General appearance and degree of apparent respiratory distress; evidence of chest trauma; vital signs, oxygen saturation, skin color, LOC; respiratory excursion, percussion tone, and breath sounds anterior and posterior chest; neck vein inspection, position of trachea; peripheral pulses.
- *Diagnostic Tests:* Chest x-ray, ABGs.

Nursing Diagnoses and Interventions

Maintaining or restoring adequate alveolar ventilation and gas exchange is of highest priority for the client with a pneumothorax. Chest tubes may interfere with physical mobility, contributing to a high risk for injury.

Impaired Gas Exchange

Loss of negative pressure in the pleural cavity and the resulting collapse of lung tissue can cause poor chest expansion and loss of alveolar ventilation. As the pneumothorax is removed or reabsorbed, ventilation and gas exchange improve.

- Assess and document vital signs and respiratory status, including rate, depth, lung sounds, and oxygen saturation at least every 4 hours. *Frequent assessment is important to monitor the adequacy of respirations and lung expansion.*

PRACTICE ALERT

Evaluate chest wall movement, position of the trachea, and neck veins frequently. Early identification of tension pneumothorax and appropriate interventions are vital to preserve cardiorespiratory function.

- Place in Fowler's or high-Fowler's position. *This position facilitates lung expansion.*
- Administer oxygen as ordered. *Supplemental oxygen is given to improve oxygenation of the blood and tissues.*

PRACTICE ALERT

Provide emotional support, particularly in early stages and during chest tube insertion. Dyspnea and hypoxemia can cause extreme anxiety and apprehension, impairing the ability to cooperate with procedures.

- Assess chest tube, system function, and drainage at least every 2 hours. *The system must remain patent and intact to function effectively.*
- Provide for rest. *Adequate rest is important to conserve energy and reduce oxygen demand.*

Risk for Injury

Pain and the presence of chest tubes can reduce the perceived ability to ambulate and provide self-care. Moderate activity is encouraged unless respiratory function is significantly impaired. Caution is taken to maintain integrity of the chest tube system. If the tube is inadvertently pulled out or system integrity is disrupted, the pneumothorax may increase or infection may develop.

PRACTICE ALERT

Avoid placing tension on chest tubes during positioning, ambulation, and care activities. The chest tubes are minimally secured to the chest wall and can be dislodged if tension is placed on them.

- Secure a loop of drainage tubing to the sheet or gown. *Looping the drainage tubing prevents direct pressure on the chest tube itself.*
- When turning to the affected side, ensure that neither the chest tube nor drainage tubing is kinked or occluded under the client. *This maintains patency of the system.*
- Teach the client how to ambulate with the drainage system, keeping the system lower than the chest. In most cases, suction can be discontinued during ambulation. *Ambulation facilitates lung ventilation and expansion. Drainage systems are portable to allow ambulation while chest tubes are in place. Keeping the drainage system lower than the chest promotes drainage and prevents reflux.*
- Observe insertion site for redness, swelling, pain, or drainage. Report any signs of infection, including fever, to the physician. *Interruption of skin integrity by chest tube insertion increases the risk for infection.*
- If a connection comes loose, reconnect it as soon as possible. *A closed, sealed system is vital to prevent air from entering the pleural space and an open pneumothorax.*

PRACTICE ALERT

Seal the wound of an open pneumothorax or a wound from inadvertent tube removal as soon as possible with a sterile occlusive dressing, such as gauze impregnated with petroleum jelly. If a sterile dressing is not available, other occlusive material such as foil or plastic wrap can be used. Tape the dressing on three sides only. An occlusive dressing taped on three sides prevents the development of a tension pneumothorax by inhibiting air from entering the wound during inhalation but allowing it to escape during exhalation.

Community-Based Care

Clients who have experienced spontaneous pneumothorax need education about their future risk. After a single episode of spontaneous pneumothorax, the risk of recurrence is 40% to 50%. This risk increases with subsequent episodes (Way & Doherty, 2003). Stress the importance of quitting smoking to reduce the risk. Other activities that can precipitate recurrent episodes include mountain climbing or those involving exposure to high altitudes, flying in unpressurized aircraft, and

scuba diving (Tierney et al., 2005). The client may be advised to avoid contact sports.

Following a pneumothorax, instruct the client to gradually increase exercise and activity to previous levels. Stress the importance of follow-up care and monitoring. Discuss manifestations to report to the physician: upper respiratory infections; fever, cough, or difficulty breathing; sudden, sharp chest pain; or redness, pain, swelling, tenderness, or drainage from the chest tube puncture wound.

THE CLIENT WITH HEMOTHORAX

Hemothorax, or blood in the pleural space, usually occurs as a result of chest trauma, surgery, or diagnostic procedures. Hemothorax develops in about 25% of clients with chest trauma, usually due to laceration of the lung, an intercostal vessel, or the internal mammary artery. If a major thoracic vessel is disrupted, hemorrhage can be massive (Yamamoto et al., 2005). Tumors, pulmonary infarction, and infections such as tuberculosis also can cause hemothorax. When blood collects in the pleural space, pressure on the affected lung impairs ventilation and gas exchange. With significant hemorrhage, a risk of shock exists.

Hemothorax causes symptoms similar to those of pneumothorax or pleural effusion. Lung sounds are diminished, and a dull percussion tone is noted over the collected blood, typically at the base of the lung. Chest x-ray is used to confirm the diagnosis of hemothorax.

Thoracentesis or thoracostomy with chest tube drainage is used to remove blood from the pleural space. With significant hemorrhage (e.g., due to trauma or surgery), the blood may be collected for subsequent autotransfusion. Blood for autotransfusion should be collected and reinfused within 4 hours. Strict aseptic technique is used in collecting the blood. It is collected through a gross particulate filter into a container primed with anticoagulant and reinfused when the container is full or when transfusion is necessary. Air is removed from the blood container prior to reinfusion and a filter used to eliminate debris, such as degenerating blood cells, fat particles, and fibrin.

Priority nursing care for the client with hemothorax focuses on assessing and maintaining adequate respiratory function and cardiac output. The priority of care depends on the rate and extent of hemothorax. In a large, slow-developing hemothorax, ventilatory status may be affected significantly. In this instance, *Impaired Gas Exchange* and *Ineffective Breathing Pattern* are priority nursing diagnoses. When hemothorax develops rapidly and hemorrhage is significant, additional priority nursing diagnoses include *Decreased Cardiac Output* and *Risk for Deficient Fluid Volume*.

When preparing the client for home care following a hemothorax, discuss the importance of avoiding smoking and preventing respiratory infection. Include symptoms to report to the physician. If trauma or infection caused the hemothorax, discuss measures to prevent future trauma and continuing treatment for the infection as indicated.

TRAUMA OF THE CHEST OR LUNG

Chest injury is a leading cause of death from trauma. It is commonly associated with motor vehicle crashes, violent crime, and falls. Chest injuries can range from mild, such as a simple rib fracture, to severe and fatal. Traumatic injury to the chest may involve both the chest wall and underlying thoracic structures, including the lungs, heart, great vessels, and esophagus. Chest and lung injury can result from several different mechanisms: penetrating trauma, such as a stab or gunshot wound; blunt trauma, such as a fall, motor vehicle crash (MVC), vehicle–pedestrian impact, or crush injury; or inhalation injury, such as smoke inhalation or near drowning.

Rapid and continuing assessment of the airway, breathing, and circulation (ABCs) is vital in chest or lung injuries. Chest trauma can disrupt any or all of these functions. Chest injuries that may be life threatening include airway obstruction, tension pneumothorax, open pneumothorax, massive hemothorax, and flail chest with pulmonary contusion.

THE CLIENT WITH A THORACIC INJURY

Thoracic injuries may be minor and have little effect on respiratory status, for example, simple rib fracture in a previously healthy client. When pain or chest wall instability impair breathing or the underlying lung tissue is damaged, the risk is more significant. Thoracic trauma usually is caused by motor vehicle crashes or falls.

Pathophysiology and Manifestations

Acceleration–deceleration injury and direct mechanisms of injury (e.g., crush injuries) are the most common mechanisms of thoracic injuries. Acceleration–deceleration injuries are caused by a rapid change in velocity such as occurs in a MVC or fall. The body stops suddenly, but the tissues and organs within the chest cavity continue to move forward until they impact with the chest wall. Injuries sustained can be significant, depending on the velocity (speed) of the vehicle or body at the point of impact, the surface with which the body impacts, and individual characteristics (e.g., size and bone structure).

Rib Fracture

Simple rib fracture, usually involving a single rib, is the most common chest wall injury. Rib fracture generally is tolerated well and heals rapidly in a young, previously healthy person. In an older adult or person with preexisting lung disease, however, a fractured rib may lead to significant complications, such as pneumonia, atelectasis, and, potentially, respiratory failure. Displaced fractured ribs can penetrate the pleura, leading to pneumothorax and possible hemothorax. Fractures of certain ribs are more frequently associated with underlying tissue damage. Intrathoracic vessels may be damaged or torn with fractures of the first and second ribs. Fractures of the seventh through tenth ribs may cause liver or spleen injuries.

Rib fracture causes pain on inspiration and coughing. This leads to voluntary splinting, with rapid, shallow respirations and inhibited cough. Bruising may be seen over the fracture, and crepitus may be palpated with respiratory movement. Breath sounds are diminished, especially in the bases, due to splinting. If pneumothorax develops, chest wall movement on the affected side may be reduced, and breath sounds absent or significantly diminished. A hyperresonant percussion tone usually is noted. Hemothorax also causes diminished or absent breath sounds on the affected side, with a dull percussion note.

Flail Chest

Multiple rib fractures may impair chest wall stability and normal chest wall function. When two or more consecutive ribs are fractured in multiple places, a free-floating segment of the chest wall, or **flail chest**, results. Physiologic function of the chest wall is impaired as the flail segment is sucked inward during inhalation and moves outward with exhalation. This is known as *paradoxic movement* (Figure 38–11 ■).

Flail chest can significantly affect ventilation and, consequently, gas exchange. Lung expansion is impaired and the work of breathing increases. Flail chest is frequently associated with underlying pulmonary contusion, which may lead to respiratory failure.

Flail chest causes dyspnea and pain, especially on inspiration. Paradoxic chest movement is evident with inspection. Chest expansion is unequal, and palpable crepitus is present. Breath sounds are diminished, and crackles may be heard on auscultation.

Pulmonary Contusion

Pulmonary contusion, or lung tissue injury, is frequently associated with flail chest and other blunt chest trauma. It may occur unilaterally or bilaterally. Pulmonary contusion often results from abrupt chest compression followed by sudden decompression, as can occur with MVC, significant fall, or crush injury. Alveoli and pulmonary arterioles rupture, causing intraalveolar hemorrhage and interstitial and bronchial edema. The resulting inflammatory response increases capillary permeability, leading to edema, which may be localized to the damaged lung tissue or more generalized. Inflammation and edema impair the production of surfactant within the alveoli, decreasing compliance. Pulmonary vascular resistance increases and blood flow decreases. Airway obstruction, atelectasis, and impaired gas diffusion result. Associated chest wall injury impairs the ability to clear secretions effectively, and the work of breathing is significantly increased.

Manifestations of pulmonary contusion may not be apparent until 12 to 24 hours after the injury. Increasing shortness of breath, restlessness, apprehension, and chest pain are early signs. Copious sputum, which may be blood tinged, is present. Later manifestations include tachycardia, tachypnea, dyspnea, and cyanosis. Even with appropriate treatment, pulmonary contusion can lead to acute respiratory distress and potential death.

INTERDISCIPLINARY CARE

Chest x-ray is used to identify most chest wall injuries. Rib fractures are evident on x-ray. Pulmonary contusion may show as initial patchy opacifications progressing to diffuse opacification, or "white-out." Changes in oxygen saturation and ABGs depend on the degree to which ventilation and gas exchange are affected by the injury.

Simple rib fractures typically heal uneventfully. Providing adequate analgesia to promote breathing, coughing, and movement is the primary intervention. With multiple rib fractures, an intercostal nerve block may be used to ensure adequate ventilation. Rib belts, binders, and taping to stabilize the rib cage are not recommended, because they may interfere with ventilation and lead to atelectasis. Even with simple rib fracture, older clients and clients with preexisting lung disease require close monitoring to prevent and detect atelectasis, pneumonia, and other complications.

Intercostal nerve blocks or continuous epidural analgesia may be employed to manage the pain associated with flail chest. For a small flail chest, analgesia combined with supplemental

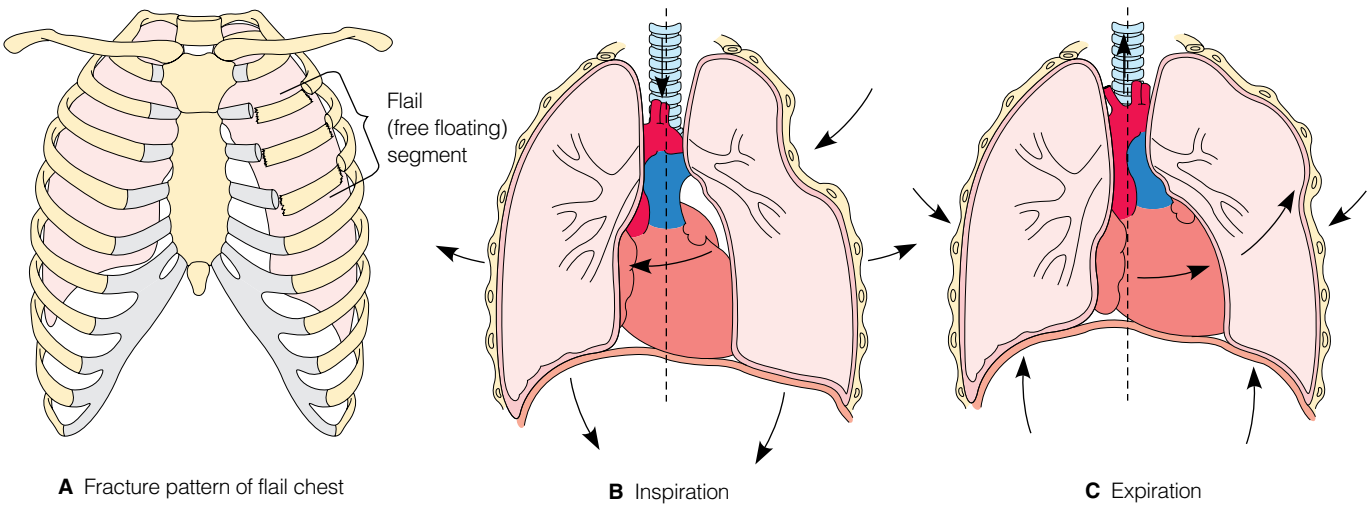


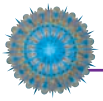
Figure 38–11 ■ Flail chest with paradoxic movement.

oxygen therapy may be adequate. In some cases, internal or external fixation of the flail segment may be done.

The preferred treatment for flail chest is intubation and mechanical ventilation. Positive-pressure ventilation provides support and stabilization of the flail segment and improves ventilation and gas exchange. The work of breathing is decreased and healing improved.

Clients with pulmonary contusion often are critically ill, requiring intensive care management. Treatment is supportive, directed at maintaining adequate ventilation and alveolar gas exchange. Endotracheal intubation and mechanical ventilation are necessary in most cases. Repeated bronchoscopy may be done to remove secretions and cellular debris, preventing atelectasis. Although adequate hydration is necessary to prevent shock, overhydration can increase pulmonary edema. Pulmonary arterial pressure monitoring with a Swan-Ganz catheter and frequent ABG measurement is required for optimal fluid replacement and management of ventilatory support. See Chapter 32 ∞ for more information about pulmonary artery pressure monitoring, and Chapter 39 ∞ for nursing care of the client who is intubated and ventilated.

Unilateral pulmonary contusion may present a unique management problem. Mechanical ventilation with positive end-expiratory pressure (PEEP) to maintain open alveoli and adequate gas exchange can damage the unaffected lung. Intubation with a double-lumen endotracheal tube that permits independent ventilation of each lung may be used.



NURSING CARE

Health Promotion

Encourage the use of seat belts, shoulder harnesses, and supplemental restraint systems such as air bags to significantly reduce the incidence of thoracic injury associated with motor vehicle crashes. Discuss the importance of appropriate protective equipment and gear for people engaging in potentially hazardous activities such as contact sports, mountain climbing, and occupations such as roofing or house painting.

Assessment

The nursing assessment of the client with a thoracic injury may need to be rapid and focused.

- *Health History:* Pain, difficulty breathing; circumstances of the injury, including position in the motor vehicle, use of restraints, speed and type of impact; distance of a fall, surface and position on impact; history of chronic lung or heart disease; smoking history.
- *Physical Examination:* Airway, breathing, circulation; LOC; color, vital signs; respiratory rate, depth, ease; symmetry of chest movement; lung sounds and percussion tone; presence of bruising, crepitus, or paradoxical chest movement.

Nursing Diagnoses and Interventions

Chest wall trauma can interfere with adequate chest expansion and alveolar ventilation. When a pulmonary contusion is also present, gas exchange is affected as well. Priorities for nursing management include controlling pain, ensuring adequate ventilation, and promoting gas exchange.

Acute Pain

With many thoracic injuries, pain interferes with lung expansion and coughing, leading to such complications as pneumonia and atelectasis. Adequate pain management is a key component of medical and nursing management for these clients.

- Frequently assess pain, using a standard pain scale and objective data. *Increased respiratory rate, shallow respirations, diminished breath sounds, and reluctance to move and cough may indicate inadequate pain control in a thoracic injury.*
- Administer analgesics by patient-controlled analgesia or on a schedule to maintain pain control. *Analgesics are more effective when pain is not allowed to become intense.*

PRACTICE ALERT

Assess for possible respiratory depression due to narcotic analgesia. Respiratory depression can further compromise ventilation in the client with thoracic injury.

- Notify the physician if pain relief is inadequate or excess sedation and respiratory depression occur. *An intercostal nerve block may be done to reduce the need for narcotic analgesia. Assess for bleeding and adequate ventilation following a nerve block.*

Ineffective Airway Clearance

Aggressive respiratory hygiene may be necessary to maintain open airways and adequate ventilation.

- Assess lung sounds and respiratory rate, depth, and effort frequently. Encourage to cough, deep breathe, and change position every 1 to 2 hours, and use the incentive spirometer. *Frequent assessment and measures to maintain airway patency are vital to prevent complications in the client with thoracic injury.*
- Teach how to splint the affected area with a blanket or pillow when coughing. *Splinting reduces movement and discomfort of the affected area.*
- Suction airway as indicated. Work with respiratory therapy to maintain optimal mechanical ventilation. Secure the endotracheal tube to maintain appropriate position and lung ventilation. *Endotracheal tube security is particularly important when a double-lumen endotracheal tube is in place, because malposition can occlude one main bronchus and prevent ventilation of the affected lung.*
- Elevate the head of the bed. *Elevating the head of the bed facilitates lung expansion and reduces the work of breathing.*

PRACTICE ALERT

Promptly report to the physician signs of complications, such as diminished breath sounds, increasing crackles (rales) or rhonchi, dull or hyperresonant percussion tones, unequal chest movement, hemoptysis, chills or fever, or changes in vital signs. Prompt intervention for complications is vital to promote healing and recovery.

Impaired Gas Exchange

Impaired gas exchange is of particular concern in pulmonary contusion. Alveolar damage and pulmonary edema can significantly impair oxygenation of the blood and removal of carbon dioxide.

- Monitor vital signs, color, oxygen saturation, and ABGs. Assess for manifestations such as anxiety or apprehension, restlessness, confusion, lethargy, or complaints of headache. *These assessment data alert the nurse and care providers to potential hypoxemia or hypercapnia due to impaired gas exchange.*
- Maintain oxygen therapy and mechanical ventilation as ordered. Hyperoxygenate prior to suctioning. *Oxygen and mechanical ventilation support alveolar gas exchange. Hyperoxygenation prior to suctioning reduces the degree of hypoxemia that occurs during suctioning.*
- Monitor intake and output, weigh daily, and monitor central venous pressure and pulmonary artery pressure as ordered. Maintain any ordered fluid restriction. *Fluid volume status is monitored to reduce the effects of pulmonary edema on lung tissues.*
- Maintain bed rest or activity restriction as ordered. Space activities to allow periods of uninterrupted rest. *Rest reduces the metabolic rate and oxygen consumption.*

Community-Based Care

Simple rib fracture and minor chest wall injuries often are managed on an outpatient basis. Include the following topics when teaching for home care:

- Pain management and its importance in preventing respiratory complications
- Importance of coughing and deep breathing; how to splint the rib cage during coughing
- Reasons for not taping or wrapping the chest continuously
- Symptoms to report to the physician: chills and fever, productive cough, purulent or bloody sputum, shortness of breath or difficulty breathing, and increasing chest pain
- Importance of avoiding respiratory irritants, such as cigarette smoke and occupational or environmental pollutants.

Significant pulmonary contusion can result in long-term respiratory insufficiency. Discuss activity modifications and occupational changes with the client and family as indicated. Refer to home care services such as respiratory therapy and home health if needed.

THE CLIENT WITH INHALATION INJURY

The internal environment of the lungs normally is protected from noxious substances by respiratory defense mechanisms. If these defenses are breached, inhaled agents, such as gases, fumes, toxins, and water, can cause internal trauma to the lungs.

Pathophysiology and Manifestations

Smoke Inhalation

Pulmonary injury due to inhalation of hot air, toxic gases, or particulate matter is the leading cause of death in burn injury (Kasper et al., 2005). Smoke inhalation affects up to one-third of clients admitted to burn units. Smoke inhalation can significantly affect normal respiratory function through three different mechanisms:

- Thermal damage to the airways, leading to impaired ventilation
- Carbon monoxide or cyanide poisoning, resulting in tissue hypoxia
- Chemical damage to the lung from noxious gases, which can impair gas exchange.

Smoke inhalation is suspected whenever a burn occurs in a closed space; if there are burns to the face or upper torso or singed nasal hairs; if sputum contains ashlike material; and when manifestations such as dyspnea, wheezing, rales, or rhonchi develop.

The lower airways of the lungs typically are protected from thermal damage by cooling of the inhaled gases in the upper airway and laryngeal spasm. Upper airway obstruction due to tissue edema and laryngeal spasm can occur quickly, however, resulting in **asphyxiation**, or oxygen deprivation, without lung damage. Steam inhalation can cause thermal damage to tissues of the lower respiratory tract.

Inhalation of carbon monoxide or cyanide gas poses an immediate threat to life. Carbon monoxide is a colorless, odorless gas produced in a fire. It binds readily with hemoglobin. The affinity of carbon monoxide for hemoglobin is 200 to 250 times stronger than that of oxygen. Hemoglobin bound to carbon monoxide reduces the oxygen-carrying capacity of blood and oxygen delivery to cells of the body. Carbon monoxide poisoning is suspected if the burn occurred in a closed space, if there is evidence of inhalation injury, or if dyspnea develops.

The manifestations of carbon monoxide poisoning depend on the level of carboxyhemoglobin saturation. When hemoglobin is 10% to 20% saturated with carbon monoxide, symptoms include headache, dizziness, dyspnea, and nausea. A characteristic "cherry-red" color of the skin and mucous membranes may be seen. With increasing levels, confusion, visual disturbances, irritability, hallucinations, hypotension, seizures, and coma develop. Permanent neurologic deficit can occur in survivors of severe, acute carbon monoxide poisoning.

Many other toxic chemicals may be present in smoke, especially in a house fire or industrial plant fire. Hydrogen cyanide can be lethal when inhaled. Inhalation of toxic chemicals causes bronchospasm and edema of the airways and alveoli. Acute respiratory distress syndrome may develop within 1 to 2 days. Sloughing of damaged mucosa leads to airway obstruction and atelectasis. Pneumonia is common following smoke inhalation.

Near-Drowning

Drowning is a leading preventable cause of accidental death in the United States. Approximately 5500 people die of drowning every year in the United States. Alcohol ingestion is a factor in about 25% of adult drowning deaths. Other circumstances that may contribute to drowning and near-drowning include excessive fatigue, a sudden acute condition such as seizure or myocardial infarction, and head or spinal cord injury associated with diving (Tierney et al., 2005).

Asphyxiation and aspiration are the primary problems associated with drowning and near-drowning. About 10% of victims

do not aspirate water; instead, laryngeal spasm causes asphyxia. This is known as "dry drowning." In most cases, however, asphyxia and hypoxemia are the result of fluid aspiration. The effects of hypoxemia occur rapidly; loss of consciousness can occur within 3 to 5 minutes after total immersion. Circulatory impairment, brain injury, and brain death can occur within 5 to 10 minutes. Immersion in very cold water and the *dive reflex,* a protective mechanism that slows the heartbeat, constricts peripheral vessels, and shunts blood to the brain and heart, may prolong survival.

Water aspiration can cause delayed death from near-drowning. Respiratory and systemic effects differ, depending on whether freshwater or saltwater has been aspirated. Freshwater is hypotonic; when aspirated, it is rapidly absorbed from the alveoli, leading to hypervolemia and hemodilution. Hemolysis occurs as blood cells are subjected to a hypotonic environment, and serum electrolytes are diluted. Electrolyte imbalances can cause cardiac dysrhythmias and death. Hemolysis can lead to acute tubular necrosis and acute renal failure. Aspiration of freshwater impairs pulmonary surfactant and damages the alveolar-capillary membrane. Respiratory failure can result.

Nearly the opposite effects occur with saltwater aspiration. As a hypertonic fluid, saltwater draws fluid into the alveoli, resulting in hypovolemia and hemoconcentration. Hemolysis is insignificant, and small elevations in serum sodium and chloride levels rarely cause life-threatening effects. With either type of near-drowning episode, inhaled microorganisms and debris can lead to pneumonia. The pathophysiologic changes associated with freshwater and saltwater near-drowning are illustrated in Figure 38–12 ■.

Manifestations of near-drowning may include altered LOC, restlessness, and apprehension. The client may complain of headache or chest pain. Other signs include vomiting, possible cyanosis, apnea, tachypnea, and wheezing. If pulmonary edema is present, pink froth may be visible in the mouth and nose. Other manifestations include tachycardia, dysrhythmias, hypotension, shock, and cardiac arrest. Hypothermia may be present.

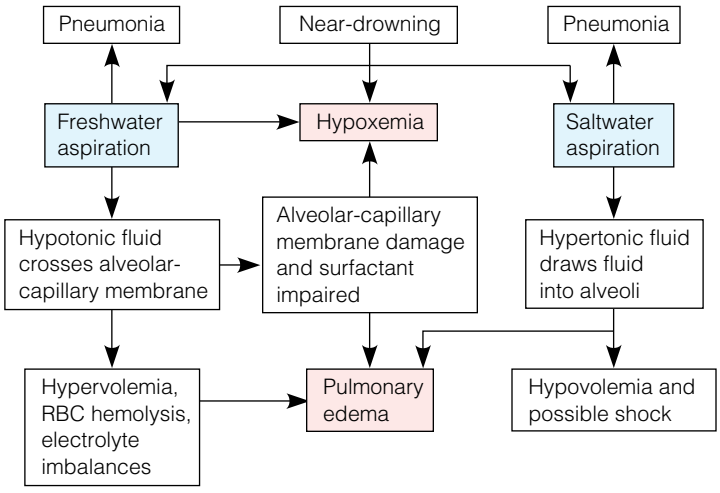


Figure 38–12 ■ The pathogenesis of near-drowning, freshwater and saltwater.

The near-drowning victim who never loses consciousness or is conscious on admission to the emergency department has a good prognosis for recovery. The prognosis is less optimistic when neurologic damage has occurred.

INTERDISCIPLINARY CARE

With inhalation injuries, the most effective treatment is prevention. A working smoke detector (with functioning batteries) could prevent the majority of deaths from smoke inhalation occurring in the home. The statement "A smoke detector was found, but the batteries had been removed" is all too familiar in news reports of fire-related deaths.

To prevent drowning, life preservers and flotation vests or jackets should be worn on the body, not stored in the hold of the boat. These devices are designed to keep the head above water. Even accomplished swimmers should never enter the water alone in unguarded areas. Just as alcohol and driving do not mix, neither do alcohol and boating or other water sports.

The second most important line of defense against death or permanent injury from inhalation injuries is removing the victim from the area of the fire or water and administering effective CPR. In many cases, immediate restoration of effective breathing and circulation is key to preserving life. Hypoxemia progresses rapidly until breathing is restored; reversal of tissue hypoxia depends on adequate circulation. In both smoke inhalation and near drowning, intubation may be necessary to establish an airway. Oxygen is administered as soon as possible. Attempts to drain water from the lungs of the near-drowning victim waste time and are generally ineffective in restoring alveolar ventilation. External cardiac defibrillation may be necessary to reestablish an effective cardiac rhythm and circulation. When the victim is hypothermic, resuscitation measures are continued until the core body temperature reaches approximately 90°F (32°C). The basic rule in hypothermia is that the client is not declared dead until the body has been rewarmed and life signs remain absent.

Diagnosis

When inhalation injury is known or suspected, the following diagnostic tests may be done:

- *ABGs* are drawn to evaluate gas exchange and the degree of hypoxemia. Combined respiratory and metabolic acidosis may be apparent. With effective ventilation and supplemental oxygen, acidosis may reverse quickly. With carbon monoxide poisoning, arterial Po_2 may be normal, but oxyhemoglobin saturation is less than normal.
- *Carboxyhemoglobin levels* are drawn in suspected carbon monoxide poisoning. Normal levels are less than 5% in nonsmokers and less than 10% in smokers. Higher levels indicate carbon monoxide poisoning. Levels less than 20% are considered mild poisoning; between 20% and 40% is moderate poisoning; and 40% to 60% is severe poisoning. Levels higher than 60% are generally fatal.
- *Serum electrolytes* and *osmolality levels* vary in near-drowning, depending on the type of water aspirated. In freshwater drowning, serum electrolyte levels and osmolal-

ity may be significantly reduced. With saltwater drowning, serum sodium and chloride may be somewhat high, and osmolality is increased because of hypovolemia.

- *Chest x-ray* is done, but may not show changes until 12 or more hours after the insult. Evidence of ARDS may be seen 24 to 48 hours after inhalation injury.
- *Bronchoscopy* may be ordered to inspect damaged lung tissue, particularly with smoke inhalation and possible thermal injury.

Treatments

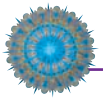
Treatment of inhalation injury is generally supportive. Endotracheal intubation and mechanical ventilation often are required to maintain the airway and provide adequate alveolar ventilation and oxygenation. All clients with inhalation injury require supplemental oxygen, even when intubation and ventilation are not required. *Hyperbaric oxygen therapy,* the delivery of 100% oxygen at increased atmospheric pressure, may be used to treat carbon monoxide poisoning. This treatment carries some risks, such as oxygen toxicity and potential trauma to lung tissues, sinuses, and ears due to the increased pressures.

Other treatment measures may include bronchodilator therapy to manage bronchospasm. Bronchodilators can be administered by aerosol inhalation or intravenous infusion. Coughing and suctioning are important to remove secretions and debris. Chest physiotherapy with percussion and postural drainage may be performed.

Intravenous fluids may be ordered; if significant hemolysis has occurred, packed red blood cells may be given to improve the oxygen-carrying capacity of the blood. Fluid therapy is monitored carefully, using pulmonary artery or central venous pressures to reduce the risk of pulmonary edema.

With near-drowning victims, measures such as inducing hypothermia or barbiturate-induced coma and administering corticosteroids and osmotic diuretics may be employed to help prevent neurologic damage.

Careful monitoring for complications such as pneumonia and ARDS is vital throughout the course of treatment. Respiratory status, vital signs, and other data are frequently assessed to identify complications and allow early intervention.



NURSING CARE

Health Promotion

Prevention of inhalation injuries is an important nursing responsibility. Teach everyone the value of a working smoke detector, especially in the sleeping areas of the house. Encourage families to develop an escape plan in case of fire and to use fire drills to rehearse getting out of the house. Smoldering cigarettes are a leading cause of house fires; help clients develop a plan to stop smoking. Teach people to drop and roll should clothing catch fire. (Flames rise, increasing the risk of respiratory injury when upright.)

Learning to swim safely is important to prevent drowning. Teach clients never to swim alone, when fatigued, or immediately following a meal. Remind clients that knowing how to swim will not prevent drowning in very cold water or in large bodies of water, such as lakes, rivers, or the ocean. Instruct to always wear flotation devices while boating, water-skiing, surfing, or wind-surfing. Wet suits help prevent hypothermia during activities in very cold water. Advise covering or fencing swimming pools, hot tubs, and ponds to prevent inadvertent entry and drowning.

A population well trained in effective, safe CPR provides the best second line of defense against inhalation injury. Rapid restoration of breathing is essential to prevent hypoxia and brain damage. Encourage all people to be trained and regularly update CPR skills. Work with communities to increase the number of trained people. Refer clients to local chapters of the American Red Cross or American Heart Association for classes.

Assessment

Inhalation injuries may be a medical emergency, necessitating focused and timely nursing assessment.

- *Health History:* Circumstances of the injury, including duration of exposure to smoke or time under water, explosion or fire in a closed area, type and temperature of water immersed in; resuscitation measures used; allergies, and current medical problems.
- *Physical Examination:* Airway, breathing, circulation; LOC; color, oxygen saturation level; vital signs; heart and lung sounds; urine output; evidence of burns or soot around nares or mouth.
- *Diagnostic Tests:* Carboxyhemoglobin levels, serum electrolytes and osmolality; ABGs; chest x-ray.

Nursing Diagnoses and Interventions

Nursing care priorities for the client with an inhalation injury are determined by the type of injury or tissue damage. Airway clearance is a major concern in all inhalation injuries, as is impaired gas exchange. Tissue hypoxia also can be a significant problem.

Ineffective Airway Clearance

Nursing measures to maintain an adequate airway begin with careful and frequent assessment of respiratory status, including rate, depth, and effort as well as breath sounds. Note amount, color, and consistency of sputum. Assist to cough frequently; suction the intubated client as needed to remove secretions. Elevate the head of the bed to facilitate alveolar ventilation unless otherwise ordered. Stabilize the endotracheal tube to prevent displacement into a mainstem bronchus, which could lead to ventilation of only one lung. Report changes in the character of secretions that may indicate complications: pink, frothy sputum suggesting pulmonary edema, or purulent sputum suggestive of pneumonia. Administer bronchodilators as ordered. Perform percussion and postural drainage as ordered.

Impaired Gas Exchange

Support gas exchange by administering supplemental oxygen, with or without mechanical ventilation. Frequently assess oxygen saturation, skin color, and mental status. Decreasing level of consciousness may be an early sign of hypoxemia. Monitor exhaled

carbon dioxide, ABGs, and pulmonary artery pressures as ordered and indicated. Report changes to the physician. Maintain oxygen flow rates as ordered. Provide frequent mouth care to reduce the discomfort of dry mucous membranes and prevent tissue breakdown. Work with respiratory therapy to maintain effective oxygen delivery with mechanical ventilation. Administer sedation as required. Maintain fluid restriction if ordered.

Ineffective Tissue Perfusion: Cerebral

Impaired cerebral tissue perfusion is a priority problem, especially with near-drowning. Hypoxia and possible hypervolemia can lead to cerebral edema and increased intracranial pressure (IICP), further impairing blood flow. Monitor vital signs and neurologic status frequently. A change in level of consciousness or behavior is typically the earliest sign of IICP. Changes noted on an intracranial pressure monitor also provide early evidence of IICP. Increasing systolic blood pressure and pulse pressure and slowed heart rate are late signs. Other manifestations may include pupillary changes and decreasing muscle strength. Report changes promptly to the physician. Elevate the head of the bed and keep the head in neutral position to promote drainage from the cranial vault. Maintain effective ventilation and oxygenation; hypercapnia and hypoxemia increase cerebral edema. Administer sedation, osmotic diuretics, or corticosteroids as ordered to reduce cerebral edema. Maintain fluid restriction. Space activities and promote rest to reduce metabolic demands.

Community-Based Care

Teach clients who do not require hospitalization for inhalation injury about symptoms that may indicate a complication and should be reported to the physician: increasing dyspnea, cough productive of purulent or pink frothy mucus, confusion, or other changes. Manifestations of respiratory damage may not be apparent for 24 to 48 hours following the injury.

Significant hypoxia due to near-drowning or carbon monoxide poisoning may cause permanent neurologic effects. Work with the family to develop communication techniques and identify remaining strengths. Help the family identify future care needs and means for meeting them, such as home health, personal care aides, or long-term care facilities. Provide social services and support group referrals.

LUNG CANCER

THE CLIENT WITH LUNG CANCER

Lung cancer is the leading cause of cancer deaths among all racial groups in the United States, accounting for 31% of all cancer deaths in men and 27% of all cancer deaths in women. In 2005, more than 168,000 people died from lung cancer in the United States; an estimated 184,800 new cases were diagnosed in that same year (American Cancer Society [ACS], 2005). It is a major health problem with a grim prognosis: Most people with lung cancer die within 1 year of the initial diagnosis.

FAST FACTS

- In the United States, the incidence of lung cancer is second to prostate cancer in men and breast cancer in women.
- Lung cancer is, however, the leading cause of cancer deaths in the United States, responsible for 31% of cancer deaths in men and 27% of cancer deaths in women.
- Tobacco use and exposure to cigarette smoke are the leading risk factors for lung cancer.

Incidence and Risk Factors

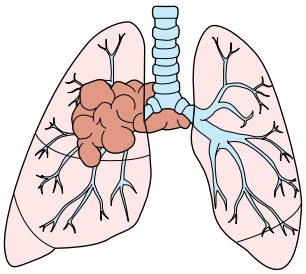
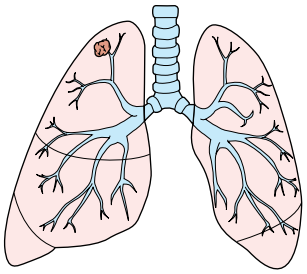
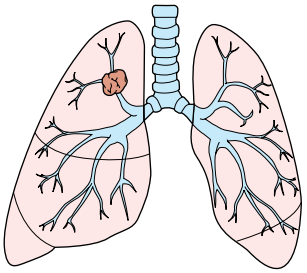
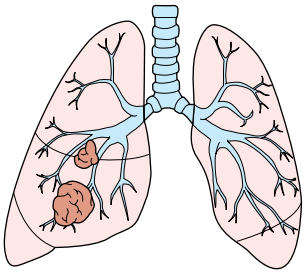
The incidence of lung cancer varies from state to state and among nations. It increases with age, occurring most commonly in clients over age 50. Family clusters of lung cancer suggest a genetic predisposition; however, exposure to tobacco smoke may be necessary for expression of the trait. Cigarette smoke, which contains 43 known chemical carcinogens and cancer promoters, is clearly the most significant cause of lung cancer (ACS, 2005). More than 80% of lung cancer cases are related to smoking, and the disease is 10 times more common in smokers than nonsmokers. There is a dose–response relationship between smoking and lung cancer; the more the person smokes and the longer the person smokes, the greater the risk. Even former smokers who have abstained for a number of years have a higher risk of developing lung cancer than nonsmokers. Exposure to ionizing radiation and inhaled irritants, asbestos in particular, is also recognized as a risk factor for lung cancer (Porth, 2005). Exposure to radon, a radioactive gas, also is identified as a lung cancer risk factor (ACS, 2005). Radon forms as radium, an element present in the earth's crust, disintegrates. Radon tends to accumulate in closed spaces where air circulation is poor, such as caves, mines, and energy-efficient houses.

Pathophysiology

Lung cancer develops as damaged bronchial epithelial cells mutate over time to become neoplastic. The genetic abnormality commonly seen is on chromosome 3, with loss of genetic material. Alterations of tumor suppressor genes also are seen in some types of lung cancer.

The vast majority of primary lung lesions are *bronchogenic carcinoma,* tumors of the airway epithelium. These tumors are further differentiated by cell type: small-cell carcinoma, adenocarcinoma, squamous cell carcinoma, and large-cell carcinoma. For clinical purposes, the latter three cell types frequently are classified together as non–small-cell carcinomas. *Small-cell carcinomas,* which account for approximately 25% of lung cancers, grow rapidly and spread early. These tumors have paraneoplastic properties; that is, they produce manifestations at sites that are not directly affected by the tumor. Small-cell lung carcinomas can synthesize bioactive products and hormones such as adrenocorticotropic hormones (ACTH), antidiuretic hormone (ADH), a parathormone-like hormone, and gastrin-releasing peptide. *Non–small-cell carcinoma* accounts for about 75% of lung cancers. Each cell type differs in its incidence, presentation, and manner of spread. Table 38–8 outlines the incidence and unique characteristics of each cell type.

TABLE 38–8 **Comparison of Lung Cancer Cell Types**

	CELL TYPE AND PREVALENCE	PRESENTATION AND ASSOCIATED MANIFESTATIONS	SPREAD
	Small-cell (oat cell) carcinoma: 20% to 25% of all lung cancers	Central lesion with hilar mass common, early mediastinal involvement, no cavitation; SIADH, Cushing's syndrome, thrombophlebitis	Aggressive tumor; more than 40% of clients have distant metastasis at time of presentation
	Adenocarcinoma: 20% to 40% of all lung cancers	Peripheral mass involving bronchi; few local symptoms; hypertrophic pulmonary osteoarthropathy	Early metastasis to CNS, skeleton, and adrenal glands
	Squamous cell carcinoma: 30% to 32% of all lung cancers	Central lesion located in large bronchi; client presents with cough, dyspnea, atelectasis, and wheezing; hypercalcemia common	Spreads by local invasion
	Large-cell carcinoma: 10% to 15% of all lung cancers	Usually, peripheral lesion that is larger than that associated with adenocarcinoma and tends to cavitate; gynecomastia, thrombophlebitis	Early metastasis

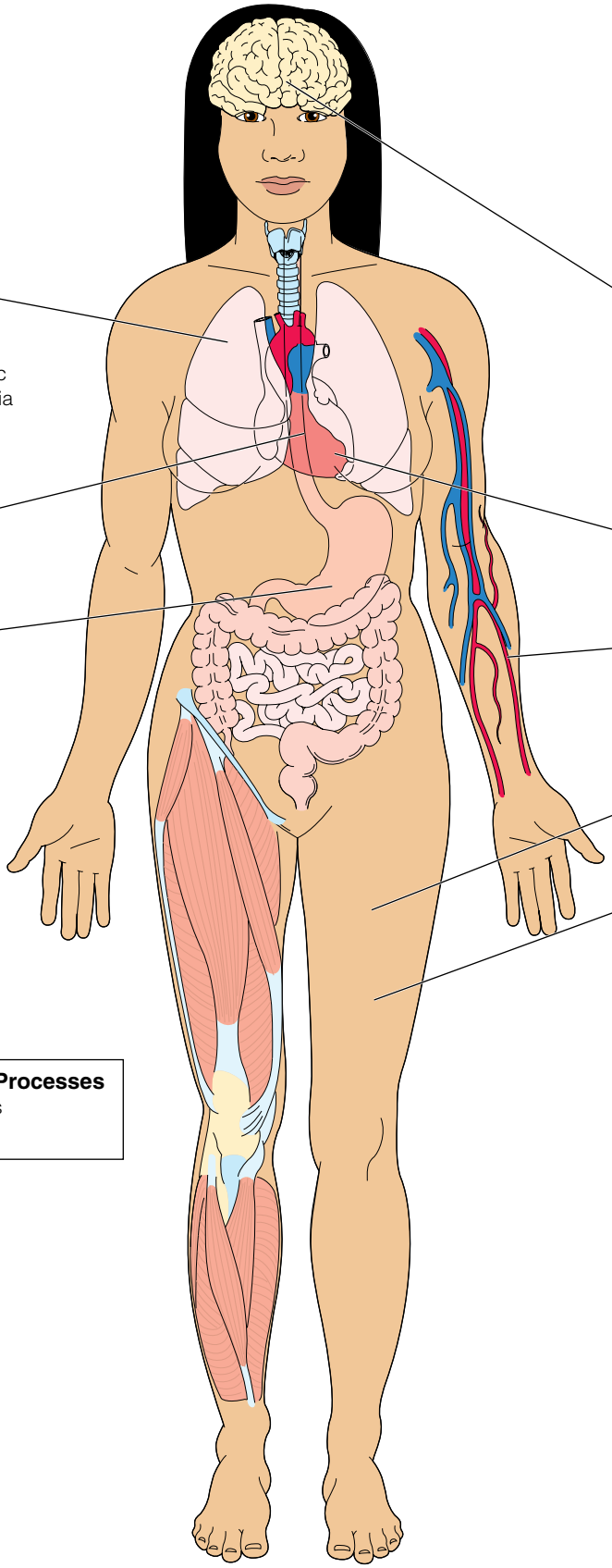
Bronchogenic cancer, regardless of cell type, tends to be aggressive, locally invasive, and have widespread metastatic lesions. Tumors begin as mucosal lesions that grow to form masses that obstruct the bronchi or invade adjacent lung tissue. All types frequently spread via the lymph system to nodes and other organs such as the brain, bones, and liver.

Manifestations

The manifestations of lung cancer are related to the location and spread of the tumor. Clients may present with symptoms related to the primary tumor, manifestations of metastatic disease, or with systemic symptoms. Initial symptoms often are attributed to smoking or chronic bronchitis. Chronic cough is common, as is hemoptysis. Wheezing and shortness of breath occur as a result of airway obstruction. Dull, aching chest pain occurs as the tumor spreads to the mediastinum; pleuritic pain occurs when the pleura is invaded. Hoarseness and/or dysphagia indicates pressure of the tumor on the trachea or esophagus.

Systemic and paraneoplastic manifestations of lung cancer include weight loss, anorexia, fatigue, and weakness; bone pain, tenderness, and swelling; clubbing of the fingers and toes; and various endocrine, neuromuscular, cardiovascular, and hematologic symptoms. The *Multisystem Effects of Lung Cancer* are illustrated on the next page.

MULTISYSTEM EFFECTS **of Lung Cancer**



Respiratory
- Cough
- Hemoptysis
- Wheezing and dyspnea
- Chest pain, dull or pleuritic
- Hoarseness and dysphagia
- Pleural effusion

Cardiovascular
- Compression of the superior vena cava

Gastrointestinal
- Anorexia

Paraneoplastic Syndromes

Endocrine System
- Hypercalcemia
- Hyperphosphatemia
- Cushing's syndrome
- Syndrome of inappropriate antidiuretic hormone (SIADH) with water retention and hyponatremia

Cardiovascular System
- Thrombophlebitis
- Endocarditis

Hematologic Effects
- Anemia
- Disseminated intravascular coagulation (DIC)
- Eosinophilia

Connective Tissue
- Osteoarthropathy with clubbing and periosteal inflammation

Neuromuscular Effects
- Peripheral neuropathy
- Cerebellar degeneration
- Myasthenia-like muscle weakness

Metabolic Processes
- Weight loss
- Fever

Confusion, impaired gait and balance, headache, and personality changes may indicate brain metastasis. Bone metastases cause bone pain, pathologic fractures, and possible spinal cord compression, as well as thrombocytopenia and anemia if bone marrow is invaded. When the liver is affected, symptoms of liver dysfunction and biliary obstruction—including jaundice, anorexia, and upper right quadrant pain—are evident.

Complications and Course

Superior vena cava syndrome, partial or complete obstruction of the superior vena cava, is a potential complication of lung cancer, particularly when the tumor involves the superior mediastinum or the mediastinal lymph nodes. Obstructed venous flow from the head and neck produces the symptoms of superior vena cava syndrome (edema of the neck and face, headache, dizziness, vision disturbances, and syncope) and may develop acutely or more gradually. Veins of the upper chest and neck are dilated; flushing occurs, followed by cyanosis. Cerebral edema may affect the level of consciousness; laryngeal edema may impair respirations.

Paraneoplastic syndromes commonly associated with lung cancer include syndrome of inappropriate ADH secretion (SIADH) with fluid retention, hyponatremia, and edema, Cushing's syndrome (see Chapter 19 ∞) related to abnormal ACTH production, and hypercalcemia. Lung tumors also may produce procoagulation factors, increasing the risk for venous thrombosis, pulmonary embolism, and thrombotic endocarditis. In lung cancer, neuromuscular symptoms such as muscle weakness and wasting of the limbs may be the first indication of the disease (Porth, 2005).

At the time of diagnosis, cancer of the lung typically is well advanced, with distant metastasis present in 55% of clients and regional lymph node involvement in another 25%. The prognosis is generally poor: The overall 5-year survival rate is only 15% (ACS, 2005).

INTERDISCIPLINARY CARE

Because lung cancer typically is advanced when diagnosed and the prognosis generally is poor, prevention of the disease must be a primary goal for all healthcare providers. With 80% of lung cancer related to cigarette smoking, reducing tobacco use can have a significant impact on the death rate from lung cancer—a far greater impact than advances in treatment.

Establishing an accurate diagnosis is the first step in treating lung cancer. Treatment decisions are based on the tumor location, type of cancer cell, staging of the tumor, and the client's ability to tolerate treatment. Lung cancer is staged by the tumor size, location, degree of invasion of the primary tumor, and the presence of metastatic disease. Lung cancer staging is summarized in Table 38–9. Surgery is the treatment of choice for most forms of lung cancer.

Diagnosis

- *Chest x-ray* usually provides the first evidence of lung cancer. It is particularly reliable as a diagnostic tool when compared with previous chest x-ray. In high-risk populations, the chest x-ray may be used as a screening tool for lung cancer.
- *Sputum specimen* is sent for *cytologic examination* to establish the diagnosis of lung cancer. The sputum sample is collected on arising in the morning. If malignant cells are found in the sputum, more expensive and invasive examinations may be unnecessary. However, a sputum sample negative for malignant cells does not rule out lung cancer; it may simply indicate that the tumor is not shedding cells into mucous secretions.

TABLE 38–9 **Lung Cancer Staging**

	PRIMARY TUMOR (T STAGE)	REGIONAL LYMPH NODES (N)	DISTANT METASTASIS (M)
	T_0—No evidence of primary tumor		
Stage 0	T_X—Malignant cells in bronchopulmonary secretions, but no tumor visualized		M_X—Presence of distant metastasis cannot be assessed
Stage I	T_1S—Carcinoma *in situ*	N_0—No regional lymph node metastasis	M_0—No distant metastasis
	T_1—Tumor that is 3 cm in diameter or less, with no evidence of invasion		
Stage II	T_2—Tumor that is greater than 3 cm in diameter, or invades visceral pleura, or has associated atelectasis or pneumonitis	N_1—Metastasis or direct extension to peribronchial or ipsilateral hilar nodes	
Stage III	T_3—Tumor with direct extension into an adjacent structure, or any tumor with associated pleural effusion or atelectasis or pneumonitis of entire lung	N_2—Metastasis to ipsilateral mediastinal or subcarinal nodes	
Stage IV	T_4—Tumor that invades mediastinum or involves the heart, great vessels, trachea, esophagus, vertebral body, or carina; presence of malignant pleural effusion	N_3—Metastasis to contralateral mediastinal, scalene, or supraclavicular nodes	M_1—Distant metastasis present

- *Bronchoscopy* is frequently done to visualize and obtain tissue for biopsy from the tumor. When a tumor mass or suspicious tissue is identified visually, a cable-activated instrument is used to obtain a biopsy specimen. If the tumor cannot be seen, the airways may be flushed with a saline solution (bronchial washing) to obtain cells for cytologic examination. Nursing care of the client undergoing a bronchoscopy is included in the Diagnostic Tests box in Chapter 36 ∞.
- *CT scan* is used to evaluate and localize tumors, particularly tumors in the lung parenchyma and pleura. It also is done prior to needle biopsy to localize the tumor. CT scanning can also detect distant tumor metastasis and evaluate tumor response to treatment.
- Cells or tissue for *cytologic examination and biopsy* may be obtained by aspirating fluid from a pleural effusion, percutaneous needle biopsy, and lymph node biopsy. These procedures may be done in an outpatient or a surgical setting.
- *CBC, liver function studies,* and *serum electrolytes* including calcium are obtained to evaluate for evidence of metastatic disease or paraneoplastic syndromes.
- *Tuberculin test (PPD)* is performed to rule out tuberculosis as the cause of symptoms and abnormalities seen on chest x-ray.
- *Pulmonary function tests (PFTs)* and *ABGs* may be performed prior to the initiation of treatment if the client has manifestations of respiratory insufficiency (e.g., dyspnea, activity intolerance, low oxygen saturation levels).

See Chapter 36 ∞ for nursing care related to commonly used diagnostic tests for lung cancer.

Medications

Combination chemotherapy (often combined with radiation therapy and/or surgery) is the treatment of choice for small-cell lung cancer because of its rapid growth, dissemination, and sensitivity to cytotoxic drugs. Used in combination, chemotherapeutic drugs allow tumor cells to be attacked at different parts of the cell cycle and in different ways, increasing the effectiveness of therapy. Fifty percent of clients with tumors at early stages achieve complete tumor remission with combination chemotherapy. When a complete tumor response is achieved in the first few cycles of chemotherapy, the chances for long-term survival are much greater.

Combination chemotherapy is used also as an adjunct to surgery or radiation therapy for other types of lung cancer. It may be used to reduce the size of advanced local tumors prior to surgery, and to lengthen survival when distant metastases are present. See Chapter 14 ∞ for further discussion of chemotherapy.

Bronchodilators may be prescribed to reduce airway obstruction. Analgesics and pain management strategies are vital when the cancer is advanced. See Chapter 9 ∞ for more information about postoperative and cancer pain management.

Surgery

Surgery offers the only real chance for a cure in non–small-cell lung cancer. Unfortunately, most tumors are inoperable or only partially resectable at the time of diagnosis. The 5-year survival rate following curative surgery in clients with resectable tumors is about 30%, with most clients succumbing to metastatic disease within 5 years (Kasper et al., 2005). The type of surgery performed depends on the location and size of the tumor, as well as the client's pulmonary and general health. The goal of surgery is to remove all involved tissue while preserving as much functional lung as possible. Table 38–10 outlines various surgical procedures used to treat lung cancer. Nursing care for the client having lung surgery is outlined in the box on page 1313.

Radiation Therapy

Radiation therapy is used alone or in combination with surgery or chemotherapy for lung cancer. The treatment goal may be either cure or symptom relief (palliative). Prior to surgery, radiation therapy is used to "debulk" tumors. When cancer has spread by direct extension to other thoracic structures and surgery is not feasible, radiation therapy may be the treatment of choice. It also may be used to relieve manifestations such as cough, hemoptysis, pain due to bone metastasis, and dyspnea from bronchial obstruction. Complications of lung cancer, such as superior vena cava syndrome, may be treated with radiation.

TABLE 38–10 **Types of Surgery for Lung Cancer**

PROCEDURE	DESCRIPTION	USED FOR
Laser bronchoscopy	Bronchoscopy-guided laser used to resect tumor	Tumors localized in a main bronchus
Mediastinoscopy	Visualization of the mediastinum using an endoscope passed through a suprasternal incision	Evaluation and biopsy of a mediastinal tumor and lymph nodes
Thoracotomy	Incision into the chest wall	Access the lung and thoracic cavity for surgery
Wedge resection	Removal of a small section (wedge) of peripheral lung tissue	Small, peripheral lung tumors
Segmental resection	Removal of an individual bronchovascular segment of a lobe	Peripheral lung tumor with no evidence of extension to the chest wall or metastasis
Sleeve resection (bronchoplastic reconstruction)	Resection of a section of a major bronchus with reconstruction of remaining normal bronchus	Small lesion of a major bronchus
Lobectomy	Removal of a single lung lobe	Tumors confined to a single lobe
Pneumonectomy	Removal of an entire lung	Tumor widespread throughout the lung, involving the main bronchus, or fixed to the hilum

NURSING CARE OF THE CLIENT HAVING Lung Surgery

PREOPERATIVE CARE

- Provide routine preoperative nursing care as outlined in Chapter 4 ∞.
- Note any history of smoking, respiratory and cardiac diseases, and other chronic conditions in the nursing history. *These factors may affect the response to surgery and the risk for postoperative complications.*
- Provide emotional and psychologic support for the client and family. *In addition to facing surgery, the client may be adjusting to a new diagnosis of cancer and the possibility that surgical intervention will be only partially successful.*
- Instruct about postoperative procedures, including respiratory therapy, breathing exercises, and coughing techniques. Allow practice time. *Learning will be easier in the preoperative period, when pain and analgesia are not affecting mental function.*
- If the client will return from surgery with an endotracheal tube and mechanical ventilation, establish a means of communication using hand or eye signals or a magic slate. *Establishing a means of communication prior to surgery reduces postoperative anxiety at being unable to speak.*
- If the client will return to the ICU, introduce the client and family to the unit and any machines, such as ventilators and monitors, that will be used. *The knowledge that this is an expected part of surgical recovery reduces the client's and family's postoperative anxiety.*

POSTOPERATIVE CARE

- Assess and provide routine postoperative care as outlined in Chapter 4 ∞.
- Assess for adequate pain control, and provide analgesics as needed. *Incisional pain commonly causes altered breathing patterns in the client who has undergone lung surgery.*
- Frequently assess respiratory status, including color, oxygen saturation, respiratory rate and depth, chest expansion, lung sounds, percussion tone, and ABGs. *Maintaining adequate ventilation and gas exchange postoperatively is vital to reduce mortality and morbidity. Gas exchange may be impaired by complications of lung surgery, including pneumothorax, atelectasis, bronchospasm, pulmonary embolus, bronchopleural fistula, and ARDS.*
- Assist with effective coughing techniques, postural drainage, and incentive spirometry. Perform endotracheal suctioning as needed while intubated. *Surgical manipulation and anesthesia can increase the mucous production, leading to airway obstruction. Aggressive pulmonary hygiene is important to prevent this complication.*
- Monitor and maintain effective mechanical ventilation. *This is vital to ensure adequate ventilation and gas exchange in the early postoperative period.*
- Maintain patent chest tubes and a closed drainage system. Monitor chest tube output every hour initially, then every 2 to 4 or 8 hours as indicated. Notify the physician if chest tube output exceeds 70 mL per hour and/or is bright red, warm, and free flowing. *Maintaining a patent, intact chest drainage system is vital to reestablish negative pressure within the chest cavity and reexpansion of the lungs. Increased amounts of warm, free-flowing blood indicate intrathoracic hemorrhage that may necessitate surgical intervention.*
- Assess for signs of infection involving the incision or chest tube site(s). Use strict aseptic technique in caring for incisions and invasive monitoring devices. *The postoperative client is at risk for incisional infections, empyema in the chest cavity, and pneumonia.*
- Assist with turning and to ambulate as soon as possible. *Early mobility is important to prevent possible complications, such as pneumonia or pulmonary embolus.*
- Assess and maintain nutritional status. Initiate enteral or parenteral nutrition early if intubation and mechanical ventilation will be required for an extended period. Provide frequent small feedings once extubated. *Maintaining nutritional status promotes wound healing and prevents negative nitrogen balance. Giving frequent small feedings reduces the fatigue associated with eating.*

Radiation therapy may be delivered by external beam to the primary tumor site or by intraluminal radiation, or brachytherapy. Radiation therapy and related nursing care are discussed further in Chapter 14 ∞. Specific nursing measures for the client undergoing radiation therapy for lung cancer are outlined in the Nursing Care box on page 1314.

Complementary Therapies

Research indicates that a significant number of clients diagnosed with lung cancer use complementary and alternative medicine (CAM). In one study of clients with lung cancer in eight European nations, 23.6% used CAM therapies (Molassiotis et al., 2006). The CAM remedies used included herbal medicines, medicinal teas, homeopathy, animal extracts, and spiritual therapies. While these therapies may be safe when used alone, the potential for interactions with conventional medical treatment must be considered. Inquire of clients about their use of complementary and alternative therapies, and inform members of the healthcare team when present.

NURSING CARE

Health Promotion

The incidence of lung cancer is decreasing as the use of tobacco products declines. Teach people of all ages, particularly children and teenagers, about the link between cigarette smoking and lung cancer. Not smoking and avoiding exposure to secondhand smoke is the primary preventive measure for lung cancer. In addition, explain the risk of lung cancer to clients with occupational risk factors, exposure to asbestos products in particular.

Assessment

Nursing assessment related to lung cancer focuses on identifying risk factors for the disease, early manifestations of lung cancer, and respiratory function in the client undergoing treatment.

- *Health History:* Current symptoms, including chronic cough, shortness of breath, blood-tinged sputum; systemic

NURSING CARE OF THE CLIENT RECEIVING Radiation Therapy

Although radiation therapy is well controlled and specifically directed toward the tumor cells, some normal cells are also damaged in the process of treatment. Nursing care and client teaching help the client cope with uncomfortable side effects associated with radiation therapy.

Nursing Responsibilities

- Monitor for potential complications:
  a. Radiation pneumonitis—dyspnea on exertion, dry cough, fever
  b. Pericarditis—chest pain, pericardial friction rub; muffled heart sounds, paradoxical pulse, ECG abnormalities (Notify the physician if symptoms develop.)
  c. Esophagitis—pain, sore throat, difficulty swallowing.
- Encourage adequate fluid intake to liquefy respiratory secretions.
- Provide local analgesics and local anesthetics such as viscous lidocaine as ordered to relieve dysphagia and sore throat.
- Offer small frequent meals of soft, cool foods and liquids to maintain nutritional status.

Health Education for the Client and Family

- If dyspnea or pneumonitis develop, teach positioning, pursed-lip techniques, and relaxation exercises to facilitate breathing.
- Reassure that pneumonitis is generally a self-limiting process and should resolve when the course of radiotherapy is completed.
- Teach the manifestations of pericarditis, which may develop during treatment or up to 1 year after its completion. Chest pain or pressure, rapid heartbeat, and fever may signal pericarditis; increasing fatigue, dyspnea, and light-headedness can indicate a chronic process with pericardial effusion and possible cardiac tamponade.
- Instruct to eliminate hot, spicy, or acidic foods from the diet if esophagitis is a problem. Alcohol and tobacco should also be avoided.
- Adequate rest and nutrition are important to alleviate the symptoms of radiation fatigue, which is common in clients receiving radiation therapy for lung cancer. The fatigue is generally temporary.

manifestations such as recent weight loss, fatigue, anorexia, bone pain; smoking history; occupational exposure to carcinogens; chronic diseases such as COPD.

- *Physical Examination:* General appearance; skin color, evidence of clubbing; weight and height; vital signs; respiratory rate, depth, excursion; lung sounds to percussion and auscultation.
- *Diagnostic Tests:* CBC and coagulation studies, serum electrolytes and osmolality, liver and renal function studies; chest x-ray and CT scan results; ABGs and oxygen saturation levels.

Nursing Diagnoses and Interventions

The client with lung cancer is facing invasive treatments with undesirable side effects, possibly surgery, and typically a poor prognosis for long-term survival. Nursing care needs are diverse, related to respiratory status, the cancer itself and possible metastases, and the treatment plan. Priority nursing diagnoses related to respiratory function include *Ineffective Breathing Pattern* and *Activity Intolerance*. *Pain* and *Anticipatory Grieving* also are likely to be high-priority problems. See the accompanying Nursing Care Plan on page 1315.

Ineffective Breathing Pattern

Breathing pattern and ventilation may be affected by the tumor itself or by treatment of the tumor. Thoracic surgery increases the risk due to the incision and disruption of the muscles of respiration. Maintaining effective lung ventilation is particularly important postoperatively to reexpand remaining lung tissue and prevent surgical complications.

- Assess and document respiratory rate, depth, and lung sounds at least every 4 hours; evaluate more frequently in the immediate postoperative period or as indicated by condition. *Early detection of signs of respiratory compromise or adventitious lung sounds is vital for effective intervention.*

PRACTICE ALERT

Monitor oxygen saturation, exhaled carbon dioxide, and/or blood gas results, reporting changes from normal. Changes in levels of blood oxygen or exhaled CO_2 may be early indications of respiratory compromise.

- Frequently assess and document pain level (using a standard pain scale); provide analgesics as needed. *Pain and attempting to avoid chest movement to prevent additional pain can lead to rapid, shallow respirations and ineffective ventilation.*
- Elevate the head of the bed to 60 degrees. *Elevating the head of the bed reduces pressure on the diaphragm and permits optimal lung expansion.*
- Assist to turn, cough, and deep breathe and use incentive spirometry. Help splint the chest with a pillow or blanket when coughing. *These measures promote airway clearance.*
- Suction airway as needed. *Suctioning may be required to remove secretions that the client is unable to cough up and expectorate.*

PRACTICE ALERT

Maintain chest tube integrity and patency by ensuring uninterrupted gravity flow. Chest tubes help reestablish negative pressure in the thoracic cavity, allowing the lung to fully reexpand.

- Provide chest physiotherapy with percussion and postural drainage as needed or ordered. *Percussion and postural drainage help maintain airway patency and effective respirations.*
- If mechanical ventilation is instituted, work with respiratory therapy and use analgesia or sedation as needed to synchronize respirations with the ventilator. *Coordination of the*

NURSING CARE PLAN A Client with Lung Cancer

After coughing up bloody sputum one morning, James Mueller, a 68-year-old retired mill worker, sees his physician. A chest x-ray shows a suspicious density in the central portion of his right lung. Mr. Mueller is admitted to the hospital the following Monday for diagnostic tests.

ASSESSMENT

Anita Sarros, RN, admits Mr. Mueller to the oncology unit and obtains a nursing history. Mr. Mueller is married and has three grown children. He worked in a local paper mill for 35 years before retiring at age 62. He describes himself as "pretty healthy," except for a chronic smoker's cough. He started smoking as a young man in the army. He has a 50 pack-year smoking history, having smoked a pack a day for 50 years, since age 18. Mr. Mueller says he briefly quit smoking following a small heart attack 3 years ago, but started again after 4 months. On further questioning, Mr. Mueller says his cough has been productive for the past few months, especially in the morning, and that he is shorter of breath than usual with activity.

Mr. Mueller's examination data include BP 162/86, P 78 and regular, R 20, and T 98.4°F (36.9°C). Color good, skin warm and dry. Inspiratory and expiratory wheezes noted in right chest but good breath sounds throughout. No other abnormal findings are noted on examination. The physician orders early morning sputum specimens times 3 days for cytologic examination and schedules a CT scan of the chest the morning after admission.

Mr. Mueller's CBC shows mild anemia, but remaining routine laboratory tests are essentially normal. Sputum cytology is positive for small-cell bronchogenic cancer. The CT scan shows a central mass approximately 4 cm in diameter with involved mediastinal and subclavicular lymph nodes. A small mass is also noted on the lumbar spine. After conferring with his physician and an oncologist, Mr. Mueller decides to undergo a trial course of chemotherapy.

DIAGNOSES

- *Ineffective Airway Clearance* related to tumor mass
- *Risk for Imbalanced Nutrition: Less than Body Requirements* related to effects of chemotherapy
- *Risk for Compromised Family Coping* related to new diagnosis of lung cancer
- *Deficient Knowledge* about lung cancer and aids to smoking cessation

EXPECTED OUTCOMES

- Maintain a patent airway.
- Maintain current weight.
- Express feelings and concerns about the effect of cancer on the family unit.
- Participate in care.
- Contact appropriate support groups.
- Verbalize an understanding of the disease, its treatment, and prognosis.
- Develop a plan to stop smoking.

PLANNING AND IMPLEMENTATION

- Teach coughing, deep breathing, and hydration measures to facilitate airway clearance.
- Discuss symptoms to report to the physician: increased dyspnea or hemoptysis, severe stridor or wheezing, chest pain.
- Discuss measures to relieve nausea associated with chemotherapy, including premedication with a prescribed antiemetic.
- Have dietitian consult with Mr. and Mrs. Mueller to develop a diet plan for maintaining ideal weight.
- Discuss possible effects of lung cancer with Mr. and Mrs. Mueller.
- Encourage Mr. and Mrs. Mueller to call a family conference to discuss the disease with their children and grandchildren.
- Evaluate family members' knowledge and understanding of lung cancer, correcting misinformation and teaching as needed.
- Have an American Cancer Society volunteer contact the family.
- Refer to local cancer support group.
- Refer to home health department for follow-up and further teaching.
- Work with Mr. Mueller to develop a plan to stop smoking.
- Ask the physician for a prescription for nicotine patches or gum for Mr. Mueller.

EVALUATION

Mr. Mueller had his first chemotherapy treatment in the hospital and was discharged 4 days after admission. After 3 months of chemotherapy, his tumor shows little regression, and a liver scan reveals further metastasis. He and his wife decide to stop chemotherapy, a decision with which the children reluctantly agree. Mr. and Mrs. Mueller are referred to hospice services. With the help of hospice nurses and volunteers, Mr. Mueller is able to remain at home. His pain is managed initially with oral MS Contin, a sustained-release form of morphine sulfate, and later with an intravenous morphine infusion. Mr. Mueller dies at home with his family at his side 9 months after his diagnosis of lung cancer.

CRITICAL THINKING IN THE NURSING PROCESS

1. The oncologist prescribed a chemotherapy regimen of cyclophosphamide, doxorubicin, and vincristine. Describe how each of these drugs works against cancer cells, and discuss the rationale for using this combination.
2. Develop a care plan to deal with the specific side effects for the above treatment regimen.
3. Mr. Mueller had small-cell (oat cell) cancer. How would his presentation and treatment differ if the diagnosis had been non–small-cell adenocarcinoma, stage $T_2N_2M_0$?
   See Evaluating Your Response in Appendix C.

client's respiratory effort with ventilator-delivered breaths is important for fully effective mechanical ventilation.

- Provide reassurance and emotional support. *These measures help relieve anxiety and promote an effective breathing pattern.*

Activity Intolerance

Both resectional lung surgery and inoperable lung cancer reduce the amount of functional lung tissue and surface area for gas diffusion. This can lead to activity intolerance if the oxygen supply is insufficient to meet the body's oxygen demand.

PRACTICE ALERT
Assess and document physiologic responses to activity, including pulse, respiratory rate, dyspnea, and fatigue. These assessments are good indicators of activity tolerance.

- Plan rest periods between activities and procedures. *Rest periods reduce oxygen demands and fatigue.*
- Assist the postoperative client to increase activities gradually. *Increasing activity levels gradually improves exercise tolerance.*
- Teach measures to conserve energy while performing ADLs, such as sitting while showering and dressing and wearing slip-on shoes. *These energy-conserving measures reduce oxygen demand and allow the client to remain independent as long as possible.*
- Keep frequently used objects within easy reach. *This helps conserve energy.*
- Administer oxygen as prescribed. Teach the client and family about home oxygen use if appropriate. *Supplemental oxygen can help improve activity and exercise tolerance.*
- Encourage maintenance of physical activity to tolerance. *Maintaining activity levels to the degree possible improves physical and emotional well-being.*
- Allow family members to provide assistance as needed. *This helps the client conserve energy and allows the family to retain a sense of usefulness.*

Pain

Pain is a priority problem in both the postoperative period as well as in the terminal stages of cancer. Poorly managed pain prolongs recovery from surgery. In the terminal cancer client, chronic and acute pain must be managed effectively to allow a peaceful death.

- Assess and document pain using a standardized pain scale and objective data. *Pain is a subjective experience, best evaluated by the client. Changes in vital signs, guarded movement, or unwillingness to move may indicate unreported pain.*
- Provide analgesics as needed to maintain comfort. *Postoperative recovery and restoration of function is facilitated by adequate pain management.*
- For cancer pain, maintain an around-the-clock medication schedule using narcotic, nonsteroidal anti-inflammatory drugs, and other medications as ordered. *Addiction is not a concern in terminal cancer; providing adequate pain relief that does not allow "breakthrough" pain is important.*
- Provide or assist with comfort measures, such as massage, positioning, distraction, and relaxation techniques. *These techniques promote relaxation and enhance pain relief.*
- Assist the client and family to plan and engage in activities that distract from pain such as reading, watching television, and engaging in social interactions. *Distraction helps the client focus away from the pain.*
- Spend as much time with the client as possible; allow family members to remain with the client. *Physical presence of the nurse and family provides emotional support for the client.*

Anticipatory Grieving

Because lung cancer often is advanced when diagnosed, the client faces the very real prospect of dying from the disease. Grieving for the anticipated loss of life is a normal response as the client and family begin to adapt to the diagnosis. Nursing care goals are to promote expression of feelings and thoughts about the loss, and to help the client and family initiate grief work, make decisions, and use appropriate resources and coping mechanisms to deal with the loss.

- Spend time with the client and family. *Time is necessary to develop a trusting, therapeutic relationship.*
- Answer questions honestly; do not deny the probable outcome of the disease. *Honesty reinforces reality and provides a sense of control over decisions to be made.*
- Encourage the client and family to express their feelings, fears, and concerns. *Open expression of feelings helps to promote understanding and acceptance.*
- Assist with understanding the grieving process and acceptance of feelings as normal. *Feelings of guilt, anger, or depression may cause the client to withdraw from others. Explanation of the grieving process enhances understanding and ability to cope.*
- Help identify strengths and coping measures that have been used effectively in the past. Provide positive reinforcement for effective coping behavior. *Past effective coping measures can help the client and family deal with the present situation and regain a sense of control.*
- Help the client and family make decisions regarding treatment and care. *This also is important to give them a sense of control.*
- Encourage use of other support systems, such as spiritual and social groups. Refer the client and family to support groups, social support services, and hospice care as indicated. Provide American Cancer Society literature and information as appropriate. *These support systems provide emotional support and help the client and family cope with the diagnosis.*
- Discuss advance directives (the Living Will) and power of attorney for health care with the client and family. *These documents give the client and family a sense of control over medical care provided if the client is no longer able to express his or her own wishes.*

Using NANDA, NIC, and NOC

Linkages between NANDA nursing diagnoses, nursing interventions, and nursing outcomes for the client with lung cancer are illustrated in Chart 38–3.

Community-Based Care

A primary teaching need to prepare the client and family affected by lung cancer for home care is information about the disease itself, expected prognosis, and planned treatment strategies. Provide honest information; do not promote false hope. Include the following additional topics in teaching for home care:

- Importance of quitting smoking, especially if surgery has been performed. (The client with lung cancer may have dif-

NANDA, NIC, AND NOC LINKAGES
CHART 38–3 **The Client with Lung Cancer**

NANDA

Ineffective Coping

↓

NIC

Coping Enhancement

Decision-Making Support

Support System Enhancement

NOC

Coping

Decision Making

Social Support

Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA Interational (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

ficulty recognizing the need to stop smoking. Include information about the effects of nicotine and the tars in cigarette smoke on healing and already compromised lung tissue.)
- Planned treatments such as chemotherapy or radiation therapy, including expected effects and usual side effects of each
- Strategies to cope with noxious effects of radiation or chemotherapy
- Activities and exercises to improve strength and regain function for the postoperative client
- The need to continue coughing and deep-breathing exercises at home
- Symptoms to report to the physician: fever, increasing or continued shortness of breath, cough, increased or purulent sputum, redness, pain, swelling, or incisional drainage
- Use of prescribed medications, including desired and potential side effects and interactions with other drugs or foods
- Use of analgesics and other pain relief measures for postoperative or cancer pain
- Information about hospice services, home health, local cancer support groups for clients and caregivers, and American Cancer Society services.

Refer the client and family for home health services including nursing care, assistance with ADLs, respiratory care, and respite care as needed.

EXPLORE MEDIALINK

Prentice Hall Nursing MediaLink DVD-ROM

Audio Glossary
NCLEX-RN® Review

Animation
Tuberculosis

COMPANION WEBSITE www.prenhall.com/lemone

Audio Glossary
NCLEX-RN® Review
Care Plan Activity: Pneumonia
Case Study: TB Medication and Compliance
MediaLink Applications
Health Promotion Among Vulnerable Populations
SARS
Links to Resources

CHAPTER HIGHLIGHTS

- Pneumonia, inflammation of the respiratory bronchioles and alveoli, usually is bacterial in origin. Different organisms are usually found in hospital-acquired pneumonia than in community-acquired pneumonia. Nursing care focuses on promoting airway clearance, supporting effective gas exchange, and promoting rest.
- Infection control measures, including standard, airborne, and contact precautions, are vital to prevent the spread of viral severe acute respiratory syndrome.
- Tuberculosis affects many people worldwide; in the United States, the primary affected populations are immigrants, people with compromised immunity, and people living in crowded or unsanitary conditions.
- The tuberculin test (PPD) detects a cellular immune response to *M. tuberculosis*, indicating infection, but not necessarily active disease.
- Effective tuberculosis treatment is a public health concern, requiring therapy and compliance monitoring, contact follow-up, and assessment for adverse treatment effects.

- Fungal lung infections tend to have a geographic pattern of distribution. People with compromised immune status are more likely to be affected. Their manifestations resemble those of pneumonia or tuberculosis.
- Disorders of the pleura, such as pleural effusion and pneumothorax, can affect lung expansion, ventilation, and gas exchange when significant.
- Tension pneumothorax develops when air enters the pleural space but is unable to escape, collapsing the lung on the affected side and placing pressure on the unaffected lung and mediastinum. Ventilation, gas exchange, venous return, and cardiac output can be significantly affected.
- Trauma may affect the chest wall (rib fracture, flail chest), the surface of the lungs (pulmonary contusion), or the airways and alveoli (smoke inhalation and near-drowning). Flail chest and pulmonary contusion often occur concurrently; hemothorax also frequently develops with chest trauma. Chest trauma (chest wall or airways) can endanger effective ventilation and gas exchange.
- Lung cancer, the leading cause of cancer deaths, typically is advanced when diagnosed. Surgery, radiation therapy, and chemotherapy are used to treat lung cancer, often in combination.
- Superior vena cava syndrome (impaired venous drainage from the head and neck) and paraneoplastic syndromes (abnormal hormone production, fluid and electrolyte imbalance, and altered clotting with possible venous thrombosis and pulmonary emboli) may complicate lung cancer.

TEST YOURSELF NCLEX-RN® REVIEW

1 Admitting orders for a client with acute bacterial pneumonia include an intravenous antibiotic every 8 hours, oxygen per nasal cannula at 5 L/min, continuous pulse oximetry monitoring, bed rest with bathroom privileges and chair at bedside as desired, diet as tolerated, sputum specimen for C&S, CBC, urinalysis, and chemistry panel. Which order should the nurse carry out first?
1. Start the oxygen per nasal cannula.
2. Insert an intravenous catheter and start the prescribed antibiotic.
3. Provide a dinner tray to the client.
4. Obtain the sputum specimen.

2 When assessing a client with bacterial pneumonia, the nurse notes that the client's overall skin tone is somewhat gray and there is a bluish tinge around the client's lips. The nurse should: (Place the following in the correct order of priority.)
1. start oxygen.
2. assess breath sounds.
3. notify the physician.
4. raise the head of the bed.
5. obtain oxygen saturation level.

3 The nurse evaluating a tuberculin test result 72 hours after it was administered notes an area of induration 9 mm in diameter. What additional information would indicate to the nurse that this is a positive result? The client
1. resides in a long-term care facility.
2. was born in Southeast Asia.
3. has HIV disease.
4. is an injection drug user.

4 The nurse teaching a client taking prophylactic daily isoniazid (INH) following tuberculin test conversion includes which of the following in the instructions?
1. This drug turns your urine red-orange. This is harmless.
2. Report numbness and tingling of your extremities to your doctor.
3. You will need to have periodic eye examinations during treatment.
4. Do not use aspirin while taking this drug because abnormal bleeding may occur.

5 Which of the following statements made by a client with a new diagnosis of lung cancer would indicate that the nurse's teaching has been effective?
1. "Well, since I'm going to die anyway, I may as well go home, put my affairs in order, and spend the rest of my time in the easy chair."
2. "I understand that because the cancer has already spread, I will be undergoing aggressive cancer treatment for the next several years to beat this thing."
3. "Even though I can't undo the damage caused by cigarette smoking, I will try to quit to prevent further damage to my lungs."
4. "Having the 'big C' is very scary; I'm just glad it is one of the more curable forms of cancer."

6 The nurse caring for a client following a lobectomy notes 100 mL of red drainage in the chest drainage container since checking it 30 minutes previously. The nurse should: (Select all that apply.)
1. empty the chest-tube drainage system.
2. note the finding and reevaluate drainage in 30 minutes.
3. notify the surgeon.
4. assess vital signs and level of consciousness.
5. apply pressure to the chest tube insertion site.

7 The nurse caring for a client having a thoracentesis appropriately assists the client to:
1. sit upright leaning forward during the procedure.
2. breathe deeply as the needle is inserted.
3. remain on quiet bed rest for 4 hours following the procedure.
4. cough as the fluid is withdrawn.

8 The nurse teaches a client being discharged from the emergency department with a diagnosis of fractured rib to:
1. avoid using pain medications to prevent respiratory depression.
2. use elastic roller bandages (ACE wraps) to stabilize the chest wall and promote comfort.
3. remain on bed rest for a week to allow the fracture to stabilize.
4. use a small pillow to splint the area when coughing.

9 Which of the following assessment findings of a client with smoke inhalation does the nurse find of greatest concern?
1. ash-like material in the sputum
2. respiratory rate of 36
3. skin and mucous membranes pink
4. fine crackles in bilateral bases

10 Which of the following nursing diagnoses does the nurse identify as of highest priority for a client with tension pneumothorax?
1. *Decreased Cardiac Output*
2. *Ineffective Breathing Pattern*
3. *Acute Pain*
4. *Risk for Aspiration*

See Test Yourself answers in Appendix C.

BIBLIOGRAPHY

Ahrens, T., Kollef, M., Stewart, J., & Shannon, W. (2004). Effect of kinetic therapy on pulmonary complications. *American Journal of Critical Care, 13*(5), 376–383.

Ailinger, R. L., Armstrong, R., Nguyen, N., & Lasus, H. (2004). Latino immigrants' knowledge of tuberculosis. *Public Health Nursing, 21*(6), 519–523.

American Cancer Society. (2005). *Cancer facts and figures 2005.* Atlanta: Author.

American Thoracic Society, CDC, & Infectious Diseases Society of America. (2003). Treatment of tuberculosis. *MMWR Recommendations and Reports, 55*(RR11), 1–77. Retrieved from: http://cdc.gov/mmwr/preview/mmwrhtml/rr5211al.htm

Banning, M. (2005). Community acquired pneumonia: Common causes, treatment and resistance. *Nurse Prescribing, 3*(5), 195–200.

Barry, R. M. (2004). Penetrating chest wounds. *RN, 67*(5), 36, 42.

Carlisle, D. (2005). Targeted TB prevention. *Community Practitioner, 78*(11), 385–386.

Cava, M. A., Fay, K. E., Beanlands, H. J., McCay, E. A., & Wignall, R. (2005). Risk perception and compliance with quarantine during the SARS outbreak. *Journal of Nursing Scholarship, 37*(4), 343–347.

Centers for Disease Control and Prevention (CDC). (2004). Fact sheet. Basic information about SARS. Retrieved from www.cdc.gov/ncidod/sars/pdf/factsheet.pdf.

_____. (2005). Public health guidance for community-level preparedness and responses to severe acute respiratory syndrome (SARS) Version 2/3. Retrieved from www.cdc.gov/ncidod/sars/guidance/index.htm

_____. (2006a). Emergence of *Mycobacterium tuberculosis* with extensive resistance to second-line drugs—worldwide, 2000–2004. *MMWR, 55*(11), 301–305.

_____. (2006b). Trends in tuberculosis—United States, 2005. *MMWR, 55*(11), 305–308.

_____. (2006c). World TB day—March 24, 2006. *MMWR, 55*(11), 301.

Chatterjee, M. (2005). Vulnerable TB patents slipping through the net. *Nursing Times, 101*(6), 7.

Chernecky, C., Sarna, L., Waller, J. L., & Bracht, M. L. (2004). Assessing coughing and wheezing in lung cancer: A pilot study. *Oncology Nursing Forum, 31*(6), 1095–1101.

Clinical rounds: Bioterrorism. How to identify inhalation anthrax. (2004). *Nursing, 34*(10), 34–35.

Coleman, P. R. (2004). Pneumonia in the long-term care setting: Etiology, management and prevention. *Journal of Gerontological Nursing, 30*(4), 14–23, 54–55.

Copstead, L. C., & Banasik, J. L. (2005). *Pathophysiology* (3rd ed.). St. Louis, MO: Elsevier/Saunders.

Darlison, L. (2005). Respiratory care. Lung cancer: An update on current diagnostic techniques and treatment. *Nursing Times, 101*(14), 42–44, 46.

DeBoer, S., & O'Connor, A. (2004). Prehospital and emergency department burn care. *Critical Care Nursing Clinics of North America, 16*(1), 61–73.

Dent, M. (2004). Hospital-acquired pneumonia: The "gift" that keeps on taking. *Nursing, 34*(2), 48–51.

Dick, J., Lewin, S., Rose, E., Zwarenstein, M., & van der Walt, H. (2004). Changing professional practice in tuberculosis care: An educational intervention. *Journal of Advanced Nursing, 48*(5), 434–442.

Dochterman, J., & Bulechek, G. (2004). *Nursing interventions classification (NIC)* (4th ed.). St. Louis, MO: Mosby.

Dreher, H. M., Dean, J. L., Moriarty, D. M., Kaiser, R., Willard, R., O'Donnell, S., et al. (2004). What you need to know about SARS now. *Nursing, 34*(1), 58–63.

Dunn, L. (2005). Pneumonia: Classification, diagnosis and nursing management. *Nursing Standard, 19*(42), 50–54.

Fontaine, K. L. (2005). *Healing practices: Alternative therapies for nursing* (2nd ed.). Upper Saddle River, NJ: Prentice Hall Health.

Gift, A. G., Jablonski, A., Stommel, M., & Given, C. W. (2004). Symptom clusters in elderly patients with lung cancer. *Oncology Nursing Forum, 31*(2), 203–210.

Grap, M. J., Munro, C. L., Hummel, R. S. III, Elswick, R. K., McKinney, J. L., & Sessler, C. N. (2005). Effect of backrest elevation on the development of ventilator-associated pneumonia. *American Journal of Critical Care, 14*(4), 325–333.

Hilton, P. (2004). Clinical. Evaluating the treatment options for spontaneous pneumothorax. *Nursing Times, 100*(28), 32–33.

Hoyert, D. L., Heron, M., Murphy, S. L., & Kung, H. C. (2006). Deaths: Final data for 2003. Health & Stats. Retrieved from www.cdc.gov/nchs/products/pubs/pubd/hestats/finaldeaths03

Jantarakupt, P., & Porock, D. (2005). Dyspnea management in lung cancer: Applying the evidence from chronic obstructive pulmonary disease. *Oncology Nursing Forum, 32*(4), 785–797.

Joseph, H. A., Shrestha-Kuwahara, R., Lowry, D., Lambert, L. A., Panlilio, A. L., Raucher, B. G., et al. (2004). Factors influencing health care workers' adherence to work site tuberculosis screening and treatment policies. *American Journal of Infection Control, 32*(8), 456–461.

Kasper, D. L., Braunwald, E., Fauci, A. S., Hauser, S. L., Longo, D. L., & Jameson, J. L. (Eds.). (2005). *Harrison's principles of internal medicine* (16th ed.). New York: McGraw-Hill.

Kim, S., & Crittenden, K. S. (2005). Risk factors for tuberculosis among inmates: A retrospective analysis. *Public Health Nursing, 22*(2), 108–118.

Kleinpell, R. M., & Elpern, E. H. (2004). Community-acquired pneumonia: Updates in assessment and management. *Critical Care Nursing Quarterly, 27*(3), 231–240.

Ladd, E. (2005). The use of antibiotics for viral upper respiratory tract infections: An analysis of nurse practitioner and physician prescribing practices in ambulatory care, 1997–2001. *Journal of the American Academy of Nurse Practitioners, 17*(10), 416–424.

Lakasing, E., & Tester, M. (2006). How to manage lung cancer in primary care. *Practice Nursing, 17*(1), 35–39.

Lehne, R. A. (2004). *Pharmacology for nursing care* (5th ed.). St. Louis, MO: Saunders.

Leonard, M. K., Osterhlot, D., Kourbatova, E. V., Del Rio, C., Wand, W., & Blumberg, H. M. (2005). How many sputum specimens are necessary to diagnose pulmonary tuberculosis? *American Journal of Infection Control, 33*(1), 58–61.

McCance, K. L., & Huether, S. E. (2006). *Pathophysiology: The biologic basis for disease in adults & children* (5th ed.). St. Louis, MO: Mosby.

McInnes, K., & Safian, L. (2005). Keeping SARS out: An education program for SARS screeners in one Ontario hospital. *Journal for Nurses in Staff Development, 21*(2), 73–78.

Merrel, P., & Mayo, D. (2004). Inhalation injury in the burn patient. *Critical Care Nursing Clinics of North America, 16*(1), 27–38.

Molassiotis, A., Panteli, V., Patiraki, E., Ozden, G., Platin, N., Madsen, E., et al. (2006). Complementary and alternative medicine use in lung cancer patients in eight European countries. *Complementary Therapies in Clinical Practice, 12*(1), 34–39.

Montgomery, S. S., Burke, E. M., Wissman, S. A., Feldman, D. S., & Leier, C. V. (2005). Natural course of large spontaneous pneumothorax. *Heart & Lung, 34*(5), 332–334.

Moorhead, S., Johnson, M., & Maas, M. (2004). *Nursing outcomes classification (NOC)* (3rd ed.). St. Louis, MO: Mosby.

Myrianthefs, P. M., Kalafati, M., Samara, I., & Baltopoulos, G. J. (2004). Nosocomial pneumonia. *Critical Care Nursing Quarterly, 27*(3), 241–257.

NANDA International. (2005). *Nursing diagnoses: Definitions and classification 2005–2006.* Philadelphia: Author.

National Center for Complementary and Alternative Medicine. (2004). Consumer advisory. Ephedra. Retrieved from http://www.nccam.nih.gov/health/alerts/ephedra/consumeradvisory

_____. (2005). Herbs at a glance. Echinacea. Retrieved from http://www.nccam.nih.gov/health/echinacea/

National Center for Health Statistics. (2005). *Health, United States, 2005 with Chartbook on trends in the health of Americans*. Hyattsville, MD: U.S. Government Printing Office.

Neafsey, P. J. (2005). Medication news. Ketolides: New antimicrobials for community-acquired pneumonia. *Home Healthcare Nurse, 23*(3), 141–143.

Nyamathi, A., Berg, J., Jones, T., & Leake, B. (2005). Predictors of perceived health status of tuberculosis-infected homeless. *Western Journal of Nursing Research, 27*(7), 896–914.

Porth, C. M. (2005). *Pathophysiology: Concepts of altered health states* (7th ed.). Philadelphia: Lippincott.

Pruitt, B., & Jacobs, M. (2006). Best-practice interventions: How can you prevent ventilator-associated pneumonia? *Nursing, 36*(2), 36–42.

Ross, J. L. (2005). Near drowning. *RN, 68*(7), 36, 42.

Rothrock, J. C. (2003). *Alexander's care of the patient in surgery* (12th ed.). St. Louis, MO: Mosby.

Ryan, B. (2005). Pneumothorax: Assessment and diagnostic testing. *Journal of Cardiovascular Nursing, 20*(4), 251–253.

Sarna, L., Brown, J. K., Cooley, M. E., Williams, R. D., Chernecky, C., Padilla, G., et al. (2005). Quality of life and meaning of illness in women with lung cancer. *Oncology Nursing Forum, 32*(1), E9–E19.

Schleder, B. J. (2004). Taking charge of hospital-acquired pneumonia. *The Nurse Practitioner, 29*(3), 50–53.

Spencer, J. W., & Jacobs, J. J. (2003). *Complementary and alternative medicine: An evidence-based approach* (2nd ed.). St. Louis, MO: Mosby.

Swigart, V., & Kolb, R. (2004). Homeless persons' decisions to accept or reject public health disease-detection services. *Public Health Nursing, 21*(2), 162–170.

Tierney, L. M. Jr., McPhee, S. J., & Papadakis, M. A. (Eds.). (2005). *Current medical diagnosis & treatment* (44th ed.). New York: McGraw-Hill.

Todd, B. (2005). Emerging infections. *Legionella* pneumonia: Many cases of Legionnaire disease go unreported or unrecognized. *American Journal of Nursing, 105*(11), 35–36, 38.

Tolomiczenko, G. S., Kahan, M., Ricci, M., Strathern, L., Jeney, C., Patterson, K., et al. (2005). SARS: Coping with the impact at a community hospital. *Journal of Advanced Nursing, 50*(1), 101–110.

Toth, A., Fackelmann, J., Pigott, W., & Tolomeo, O. (2004). Tuberculosis prevention and treatment: Occupational health, infection control, public health, general duty staff, visiting, parish nursing or working in a physician's office—all nursing roles are key in improving tuberculosis control. *Canadian Nurse, 100*(9), 27–30.

Tseng, H., Chen, T., & Chou, S. (2005). SARS: Key factors in crisis management. *Journal of Nursing Research, 13*(1), 58–64.

Understanding pleural effusion. (2004). *Nursing, 34*(8). 64.

Vecchiarino, P., Bohannon, R. W., Ferullo, J., & Malijanian, R. (2004). Short-term outcomes and their predictors for patients hospitalized with community-acquired pneumonia. *Heart & Lung, 33*(5), 301–307.

Way, L. W., & Doherty, G. M. (2003). *Current surgical diagnosis & treatment* (11th ed.). New York: McGraw-Hill.

Wilkinson, J. M. (2005). *Nursing diagnosis handbook* (8th ed.). Upper Saddle River, NJ: Prentice Hall.

Williams. V. G. (2006). Tuberculosis: Clinical features, diagnosis and management. *Nursing Standard, 20*(22), 49–53.

Willis, D., VanSickle, D., Van Riper, S., & Valerio, C. (2005). Pneumonia: Bringing JCAHO and CMS to the bedside. *American Journal of Nursing, 105*(3), 72A, 72C–72D.

Wing, S. (2004). Pleural effusion: Nursing care challenge in the elderly. *Geriatric Nursing, 25*(6), 348–354.

Withy, K., & Alper, B. S. (2005). Stat consult. Acute bronchitis. *Clinical Advisor for Nurse Practitioners, 8*(1), 73–74, 77.

Woods, A., & Hathaway, L. (2004). Treating community-acquired pneumonia. *Nurse Practitioner, 29*(6), 11.

World Health Organization. (2003). Cumulative number of reported probable cases of severe acute respiratory syndrome (SARS). *Communicable Disease Surveillance & Response (CSR).* Author.

Yamamoto, L., Schroeder, C., Morley, D., & Beliveau, C. (2005). Thoracic trauma: The deadly dozen. *Critical Care Nursing Quarterly, 28*(1), 22–40.