The respiratory unit focuses on conditions that interfere with gas exchange. When problems of gas exchange occur, regardless of the precipitating cause, a hypoxic state is frequently the result. A thorough understanding of hypoxia and appropriate nursing interventions for the hypoxic client is necessary for an understanding of the disease processes and ensuing nursing interventions.

PHYSIOLOGY OF THE RESPIRATORY SYSTEM

Organs of the Respiratory System

A. Larynx.
   1. Lies in the middle of the neck.
   2. Controls airflow and prevents foreign objects from entering the airway.
   3. Vocal cords are located in the lower aspect of the larynx.
   4. Glottis: the opening of the vocal cords and the narrowest portion of the laryngeal cavity.
   5. Epiglottis: the area immediately above the glottis.

B. Trachea.
   1. Extends from the larynx downward into the thoracic cavity.
   2. Contains cartilage rings to maintain the patency of the airway to the lungs.

C. Bronchial tree (Figure 10-1).
   1. Trachea divides below the carina into the right and left main stem bronchi, which extend into the lungs.
   2. The right main stem bronchus is shorter, wider, and straighter than the left; therefore foreign objects are more likely to enter the right side.

D. Lungs (organs of respiration).
   1. Divided into lobes.
      a. Right lung: three lobes.
      b. Left lung: two lobes.
   2. Each terminal bronchiole branches into respiratory bronchioles.
   3. The alveolar ducts are located at the end of the respiratory bronchioles.
   4. Alveoli: area of gas exchange; diffusion of O2 and CO2 between the blood and the lungs occurs across the alveolar membrane.
   5. Surfactant is produced in the alveoli; primary functions are to facilitate alveolar expansion and to decrease tendency of alveoli to collapse.

6. Premature infants may have inadequate production of surfactant.
7. Blood supply to the lungs.
   a. Pulmonary arteries to pulmonary capillaries to alveoli, where exchange of gas occurs.
   b. Bronchial arteries supply the nutrients to the lung tissue and do not participate in gas exchange.

Physiology of Respiration

External respiration is a process by which gas is exchanged between the circulating blood and the inhaled air.
A. Atmospheric pressure: pressure exerted on all body parts by surrounding air.
B. Intrathoracic pressure: pressure within the pleural cavity.
C. Gases flow from an area of high pressure to an area of low pressure; pressure below atmospheric pressure is designated as negative pressure.

D. Inspiration.
1. Stimulus to the diaphragm and the intercostal muscles by way of the central nervous system (CNS).
2. As the diaphragm expands and the chest rises, a negative pressure is created within the lungs.
3. Through the open airways, the lungs are exposed to atmospheric pressure. Air will flow into the lungs to equalize intrathoracic pressure with atmospheric pressure.

E. Expiration.
1. Diaphragm and intercostal muscles relax and return to a resting position; therefore lungs recoil and capacity is decreased.
2. Air will flow out until intrathoracic pressure is again equal to atmospheric pressure.

F. Compliance describes how elastic the lungs are or how easily the lungs can be inflated; when compliance is decreased, the lungs are more difficult to inflate.

G. Control of respiration.
1. Movement of the diaphragm and accessory muscles of respiration is controlled by the respiratory center located in the brainstem (medulla oblongata and pons). The respiratory center will control respirations by way of the spinal cord and phrenic nerve. The diaphragm and intercostal muscles are innervated by the nerves that originate from the spinal cord.
2. The medulla contains the central chemoreceptors responsive to changes in CO₂ blood levels. Increased CO₂ is the normal mechanism stimulating breathing.

NURSING PRIORITY: In normal clients, when the Paco₂ is increased, ventilation is initiated.

3. Carotid and aortic bodies contain the peripheral chemoreceptors for arterial O₂ levels.
   a. Primary function is to monitor arterial O₂ levels and stimulate the respiratory center when a decrease in Paco₂ occurs.
   b. When arterial O₂ concentration decreases to below 60 mm Hg, stimulation to breathe is initiated by the chemoreceptors.
   c. In a person whose primary stimulus to breathe is hypoxia, the receptors in the carotid and aortic bodies that are sensitive to oxygen levels then become the mechanism for control of ventilation.

H. The process of gas exchange.
1. Ventilation: the process of moving air between the atmosphere and alveoli.
2. Diffusion.

a. The process of moving O₂ and CO₂ across the alveolar capillary membrane.

b. Gas diffuses across the alveolar capillary membrane from an area of high concentration to an area of low concentration.

NURSING PRIORITY: Retained mucus that pools in the lung will decrease diffusion as well as provide a reservoir for bacteria and infection.

3. Perfusion.
   a. The process of linking the venous blood flow to the alveoli.
   b. Dependent on the volume of blood flowing from the right ventricle into and through the pulmonary circulation.

TEST ALERT: Integrate knowledge of biological sciences in caring for clients.

Oxygen and Carbon Dioxide Transport

Internal respiration is the exchange of gases between the blood and interstitial fluid. The gases are measured by an analysis of arterial blood.

A. O₂:
   1. Transported as a dissolved gas; Pao₂ refers to the partial pressure of O₂ in arterial blood.
   2. O₂ is bound to hemoglobin; when hemoglobin leaves the pulmonary capillary bed, it is usually 95% to 100% saturated with O₂. It may be referred to as the arterial oxygen saturation (Sao₂).
   3. Oxygenated hemoglobin moves through the arterial system into the cellular capillary bed, where O₂ is released from the hemoglobin and made available for cellular metabolism.

B. Hemoglobin binds with O₂ in an alkaline condition; hemoglobin releases O₂ more rapidly in an acidotic state.

C. A decrease in the arterial O₂ tension (Pao₂) and a decrease in the saturation of the hemoglobin with oxygen (Sao₂) results in a state of hypoxemia.

D. Effects of altitude on oxygen transport
   1. At high altitudes (above 10,000 feet), there is reduced O₂ in the atmosphere, resulting in a lower inspired O₂ pressure and a lower Pao₂. Commercial planes are pressurized to an altitude of 8000 feet.

NURSING PRIORITY: Clients who require supplemental oxygen should consult with their physician before planning air travel.
TABLE 10-1 CONSIDERATIONS IN THE RESPIRATORY ASSESSMENT OF THE OLDER ADULT CLIENT

<table>
<thead>
<tr>
<th>BODY CHANGES</th>
<th>RESPIRATORY CHANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyphosis</td>
<td>Decreased ability to cough and deep breathe effectively</td>
</tr>
<tr>
<td>Decreased chest expansion</td>
<td>Decreased O2 levels, increased risk for atelectasis</td>
</tr>
<tr>
<td>Decreased ability to handle secretions</td>
<td>Increased risk for aspiration, atelectasis and pneumonia.</td>
</tr>
<tr>
<td>Decreased chest expansion</td>
<td>Decreased oxygenation, increased risk for hypoventilation</td>
</tr>
<tr>
<td>Altered pulmonary function</td>
<td>Decreased breath sounds, deceased vital capacity, increased residual volume</td>
</tr>
<tr>
<td>Decreased/impaired immune response</td>
<td>Increased risk of pulmonary infections</td>
</tr>
</tbody>
</table>

2. The body will increase in the number of red blood cells, thereby increasing the total hemoglobin-carrying and O2-carrying capacity of the blood.

3. Renal erythropoietic factor (erythropoietin) is released, thereby enhancing the production of red blood cells (secondary polycythemia). It takes approximately 4 to 5 days to actually increase red blood cell production.

**System Data Collection**

A. History.
      a. Tuberculin (TB) skin test (also known as PPD or Mantoux test).
      b. Determine status of childhood vaccinations.
      c. Adult - tetanus, pneumococcal pneumonia vaccine (Pneumovax).
   3. History of medication use - including OTC, prescriptions, herbs, and vitamins.
   4. Lifestyle and occupational environments.
   5. Tobacco use and alcohol intake.

B. Physical data collection. (Table 10-1)

**NURSING PRIORITY:** Identify progressive changes in respiratory status; primary indicators of respiratory disorders are sputum production, cough, dyspnea, hemptysis, pleuritic chest pain, fatigue and changes in breath sounds.

1. Observe client’s resting position.
   a. Does client appear comfortable and not in distress?
   b. Determine client’s respiratory status in the sitting position if possible.
   c. Is there any dyspnea or respiratory discomfort?

**NURSING PRIORITY:** If there is evidence of respiratory difficulty, keep client at rest in sitting position or in semi-Fowlers position, begin oxygen and request assistance.

2. Evaluate vital signs.
   a. Are vital signs appropriate for age level?
   b. Establish database and compare with previous data.
   c. Assess client’s overall response, pattern of vital signs; normal vital signs vary greatly from one individual to another (see Table 3-1).

3. Inspect the neck for symmetry; determine if the trachea is in midline and observe for presence of jugular vein distention.

4. Assess the lungs.
   a. Visually evaluate the chest/thorax.
      (1) Do both sides move equally?
      (2) Observe characteristics of respirations and note whether retractions are present on the chest wall.
      (3) Note chest wall configuration (barrel chest, kyphoscoliosis, etc.).
      (4) Are retractions present on the chest wall?
   b. Palpate chest for tenderness, masses, and symmetry of motion.
   c. Auscultate breath sounds; begin at lung apices and end at the bases, comparing each area side to side. Breath sounds should be present and equal bilaterally.
   d. Determine presence of adventitious breath sounds (abnormal/extra breath sounds).
      (1) Crackles: usually heard during inspiration and do not clear with cough; occur when airway contains fluid (previously also known as rales).
      (2) Wheezes: may be heard during inspiration and/or expiration; are caused by air moving through narrowed passages; sound is music-like and continuous.

5. Assess cough reflex and sputum production.
   a. Is cough associated with pain?
   b. What precipitates coughing episodes?
   c. Is cough productive or nonproductive?
   d. Characteristics of sputum.
      (1) Consistency.
      (2) Amount.
(3) Color (should be clear or white).
e. Presence of hemoptysis.

6. Assess for abnormal respiratory pattern.
a. Hyperventilation: increased rate and depth of
   respiration often associated with loss of CO₂.
b. Tachypnea: rapid, shallow breathing that may be
   associated with CO₂ retention.
c. Bradyphnea: slow, regular breathing; may be
   induced by anesthetic or narcotics.
d. Cheyne-Stokes: episodes of apnea alternating
   with hyperventilation.
e. Kussmaul’s respiration: rapid, deep breathing
   associated with metabolic acidosis (diabetic
   acidosis).

7. Assess for and evaluate dyspnea.
a. Onset of dyspnea and precipitating causes.
b. Presence of orthopnea.
c. Presence of adventitious breath sounds.
d. Noisy expiration.
e. Level of tolerance of activity.
f. Correlate with vital signs, pulse oximetry and
   arterial blood gases.
g. Cyanosis (a very late and unreliable sign of
   hypoxia).
   (1) For dark-skinned clients, assess the areas
    that are less pigmented (oral cavity, nail
    beds, lips, palms).
   (2) Dark-skinned clients may exhibit cyanosis
    in the skin as a gray hue, rather than blue.

8. Assess for and evaluate chest pain.
a. Location of pain.
b. Character of pain.
c. Pain associated with cough.
d. Pain either increased or decreased with
   breathing.

9. Evaluate fingers for clubbing (characteristic in
   clients with chronic respiratory disorders).

10. Evaluate pulmonary diagnostics (see Appendix 10-1).
a. Hemoglobin and hematocrit (presence of
    polycythemia or anemia).
b. Electrolyte imbalances.
c. Arterial blood gases (ABGs, Table 10-2).
d. Status of pulse oximetry (SpO₂) (Appendix 10-1)

### TABLE 10-2 NORMAL ARTERIAL BLOOD GAS VALUES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity index</td>
<td>pH</td>
</tr>
<tr>
<td>Partial pressure of dissolved oxygen</td>
<td>PaO₂</td>
</tr>
<tr>
<td>Percentage of hemoglobin saturated with oxygen</td>
<td>SaO₂</td>
</tr>
<tr>
<td>Partial pressure of dissolved carbon dioxide</td>
<td>PaCO₂</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>HCO₃⁻</td>
</tr>
</tbody>
</table>

**NURSING PRIORITY:** An SaO₂ below 95% is indicative of poor ventilation and requires immediate nursing action.

**TEST ALERT:** Modify client’s care based on the results of diagnostic/lab tests.

### Hypoxia

*Hypoxia is a condition characterized by an inadequate amount of oxygen available for cellular metabolism.*

**NURSING PRIORITY:** Problems with respiratory status occur in all nursing disciplines. Questions may center around nursing priorities and nursing interventions in maintaining an airway and promoting ventilation in the client with respiratory difficulty. The questions may arise from any client situation (e.g., obstetrics, newborn, surgical, etc.)

A. Hypoxemia: decreased oxygen saturation of the blood.
B. Hypoxia may be caused by inadequate circulation.
   1. Shock.
   2. Cardiac failure.
C. Anemia precipitates hypoxia caused by a decrease in the O₂-carrying capacity of the blood.
   1. Inadequate red blood cell production.
   2. Deficient or abnormal hemoglobin.

**Data Collection**

A. Risk factors/etiology.
   1. Chronic hypoxia.
      a. Chronic obstructive pulmonary disease (COPD).
      b. Cystic fibrosis.
      c. Cancer of the respiratory tract.
      d. Heart failure.
      e. Chronic anemia.
   2. Inflammatory problems affecting alveolar surface
      area and membrane integrity (e.g., pneumonia,
      bronchitis).
   3. Acute hypoxia.
      a. Acute respiratory failure.
      b. Sudden airway obstruction.
      c. Conditions affecting pulmonary expansion (e.g.,
         respiratory paralysis).
d. Conditions causing decreased cardiac output (heart failure, shock, cardiac arrest, etc.).
e. Hypoventilation (brain attack or stroke, sedation, anesthesia, etc.).

B. Clinical manifestations: underlying respiratory problem, either chronic or acute (Table 10-3).
C. Diagnostics: see Appendix 10-1.

C. Diagnostics: see Appendix 10-1.
1. Arterial blood gases.
2. Pulse oximetry
3. Hemoglobin and hematocrit levels.

Nursing Interventions

Goal: To maintain good pulmonary hygiene and prevent hypoxic episode.
A. Position client to maintain patent airway.
1. Unconscious client: position on side with the chin extended, and head slightly elevated.
2. Conscious client: elevate the head of the bed and may position on side as well.
B. Encourage effective coughing and deep breathing (Box 10-1).
C. Suction client’s secretions as needed and as indicated by amount of sputum and ability to cough.
D. Maintain adequate fluid intake to keep secretions liquefied, 3000 to 4000mL daily (unless contraindicated by cardiac or renal problems).
E. Encourage exercises and ambulation as indicated by condition.
F. Administer expectorants.
G. Administer O₂ if dyspnea is present.
H. Prevent aspiration (Box 10-3).

TEST ALERT: Implement measures to manage/prevent possible complications of a client condition or procedure (aspiration).

**TABLE 10-3 SYMPTOMS OF RESPIRATORY DISTRESS AND HYPOXIA**

<table>
<thead>
<tr>
<th>EARLY SYMPTOMS</th>
<th>LATE SYMPTOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restlessness</td>
<td>Extreme restlessness to stupor</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>Severe dyspnea</td>
</tr>
<tr>
<td>Tachypnea, exertional dyspnea</td>
<td>Slowing of respiratory rate</td>
</tr>
<tr>
<td>Orthopnea, tripod positioning</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>Anxiety, difficulty speaking</td>
<td>Cyanosis (peripheral or central)</td>
</tr>
<tr>
<td>Poor judgment, confusion</td>
<td></td>
</tr>
<tr>
<td>Disorientation</td>
<td></td>
</tr>
</tbody>
</table>

**PEDIATRICS**

| Flaring nares (infants)              | Mottling, pallor, and cyanosis                              |
| Substernal, suprasternal, supraclavicular and intercostal retractions (see Figure 10-2) | Sudden increase or sudden decrease in agitation |
| Stridor—expiratory and inspiratory   | Decrease in breath sounds                                   |
| Increased agitation                  | Altered level of consciousness                              |
|                                      | Inability to cry or to speak                                |

**BOX 10-1 EFFECTIVE COUGHING**

• Increase activity before coughing: walking or turning from side to side.
• Place client in sitting position, preferably with feet on the floor.
• Client should turn his or her shoulders inward and bend head slightly forward.
• Take a gentle breath in through the nose and breathe out completely.
• Take two deep breaths through the nose and mouth and hold for 5 seconds.
• On the third deep breath, cough to clear secretions.
• Sips of warm liquids (coffee, tea, or water) may stimulate coughing.
• Demonstrate to client how to splint chest or incision during cough to decrease pain.

Goal: To assess and implement nursing measures appropriate to current level of hypoxia.
A. Assess patency of airway (first/highest priority).
1. Can client speak? If not, initiate emergency procedures (see Appendix 10-3).
2. If speaking is difficult because of level of hypoxia, place in semi-Fowler’s position, begin oxygen, obtain assistance, and remain with client.
3. If client is able to speak in sentences and is coherent, continue with assessment of the problem.
4. Evaluate amount of secretions and ability to cough; suction and administer O₂ as indicated.
B. Assess use of accessory muscles, presence of retractions.
C. Maintain calm approach, because increasing anxiety will potentiate hypoxia. Remain with the client who is experiencing severe dyspnea and call for assistance.

D. Place adult or older child in a semi-Fowler’s position, if not contraindicated.

E. Place infant in an infant seat or elevate the mattress.
   a. Cyanosis that increased with crying is usually of a cardiac origin, cyanosis that decreases with crying is usually of a respiratory origin.
   b. Cyanosis may be present in the mucus membranes in the mouth or the inner aspect of the lips and gum.

F. Assess client’s color, presence of retractions and presence of diaphoresis.

G. Evaluate vital signs: Are there significant changes from previous readings?

H. Assess for tachycardia.

I. Evaluate chest movements: Are they symmetrical?

J. Evaluate anterior and posterior breath sounds.

K. Assess client for chest pain with dyspnea.

L. Report findings that indicate respiratory compromise.

M. Assess response to O₂ therapy.

N. Monitor levels and changes in pulse oximetry.

NURSING PRIORITY: Position a dyspneic client in semi-Fowler’s or high Fowler’s. A pillow placed lengthwise behind the client’s back and head may increase comfort; do not flex the client’s head backward or forward.

Pneumothorax

* Air in the pleural space results in the collapse or atelectasis of that portion of the lung, which results in a pneumothorax.

* Tension pneumothorax: the development of a pneumothorax that allows excessive buildup of air and pressure in the pleural space.
   - Causes a shift of the trachea out of the sternal notch to the unaffected side.
   - A tension pneumothorax can rapidly become an emergency situation.
Data Collection
A. Risk factors/etiology.
   1. Ruptured bleb (spontaneous).
   2. Thoracentesis.
   3. Infection.
   4. Trauma (penetrating or blunt chest injury).
B. Clinical manifestations.
   1. Dyspnea, hypoxia
   2. Tachycardia, tachypnea
   3. Sudden, sharp pleural chest pain, especially on inspiration.
   4. Anxiety with increasing restlessness.
   5. Asymmetrical chest wall expansion.
   6. Diminished or absent breath sounds on the affected side.
   7. Possible development of a tension pneumothorax.
      a. Decreased cardiac filling, leading to decreased cardiac output.
      b. Tracheal shift from midline toward unaffected side.
      c. Increasing problems of hypoxia.
C. Diagnostics: see Appendix 10-1.

NURSING PRIORITY: When atmospheric pressure is allowed to disrupt the negative pressure in the pleural space, it will cause the lung to collapse. This requires chest tube placement to reestablish negative pressure and reinflate the lung.

Treatment
Placement of chest tubes connected to a water-sealed drainage system (see Appendix 10-4 and Figure 10-6).

Nursing Interventions
- Goal: To recognize the problem and prevent a severe hypoxic episode (see Hypoxia, Nursing Interventions).
  A. Report deterioration of client’s respiratory status.
  B. Maintain client on bed rest in semi–Fowler’s position and begin O₂ therapy.
- Goal: To reinflate lung without complications.
  A. Have client cough and deep-breathe every 2 hours.
  B. Encourage exercise and ambulation.
  C. Establish and maintain water-sealed chest drainage system (see Appendix 10-4).

Chest Trauma
- An open or “sucking” chest wound is frequently caused by a penetrating injury to the chest.

NURSING PRIORITY: If a chest tube is inadvertently pulled out of the chest, a sucking chest wound may be created.
Pulmonary Embolism

* An obstruction of a pulmonary artery, most often caused by a blood clot (deep vein thrombosis (DVT) or thrombus that becomes mobile (embolus). May also be caused by air, fat, amniotic fluid, bone marrow, or sepsis.

A. The severity of the problem depends on the size of the embolus.
B. The majority of pulmonary emboli arise from thrombi in the deep veins of the legs.
C. A pulmonary embolism must originate from the venous circulation, or the right side of the heart.

Test Alert: Implement measures to manage/prevent possible complications of a client condition or procedure (circulatory complication).

Data Collection

A. Common risk factors/etiology.
   1. Conditions or immobility predisposing to venous stasis and/or deep vein thrombosis: surgery, stroke, spinal cord injury, and prolonged periods of sitting (e.g. airline flights).
   2. DVT: the thrombus spontaneously dislodges secondary to jarring of the area—sudden standing, changes in rate of blood flow (Valsalva maneuver, increased BP).
   3. Pregnancy, obesity.
   4. Fractures of long bones causing a fat embolus.
B. Clinical manifestations.
   1. Classic triad of symptoms: dyspnea, chest pain, and hemoptyensis occurs in only 20% if clients.
   2. Most common symptoms.
      a. Increased anxiety.
      b. Sudden, unexplained dyspnea.
      c. Tachypnea.
      d. Tachycardia.
      e. Hypoxia.
   3. Hypotension and syncope.
   4. May result in sudden death if pulmonary embolism is large.
C. Diagnostics: see Appendix 10-1.

Treatment

A. Bed rest, semi-Fowler’s position if BP permits.
B. Respiratory support: O₂, possibly assisted ventilation.
C. Anticoagulants (heparin, low-molecular-weight heparin, or warfarin) to prevent further thrombus formation.
D. IV access for fluids and medications to maintain blood pressure.
E. Small doses of morphine sulfate may be used to decrease anxiety, alleviate chest pain, or improve tolerance to endotracheal tube.
F. Thrombolytics.

Nursing Interventions

Goal: To identify clients at increased risk and prevent and/or decrease venous stasis (see Box 11-3).

A. Older adults are at increased risk of DVT.
B. Clients that are at high risk
   1. Orthopedic surgery, knee and hip replacements.
   2. Clients with fractures of long bones.
   3. Clients requiring bed rest (cardiac, stroke).
C. Prevention of DVT – (see Chapter 11, Box 11-3)

Goal: To identify problem and implement nursing measures to alleviate hypoxia (see Hypoxia, Nursing Interventions).

Goal: To monitor client’s respiratory function and response to treatment.

Croup Syndromes

The term croup describes a group of conditions characterized by edema and inflammation of the upper respiratory tract.

A. Acute epiglottitis: a severe infection of the epiglottis, characterized by rapid inflammation and edema of the area.
   1. Generally occurs in children 2 to 7 years old; may rapidly cause airway obstruction.
   2. Cause: most commonly Haemophilus influenza.
   3. Clinical manifestations: hypoxia (see Table 10-3).
      a. Rapid, abrupt onset.
      b. Sore throat, difficulty in swallowing.
      c. Symptoms of increasing respiratory tract obstruction.
         (1) Characteristic position: sitting with the neck hyperextended (sniffing position) and mouth open (tripod position), drooling.
         (2) Inspiratory stridor (crowing).
         (3) Retractions – intercostal, suprasternal and substernal. (Fig 10-2).
         (4) Increased restlessness and apprehension.
      d. High fever (above 102° F).

Nursing Priority: The presence of drooling with the absence of spontaneous cough are very distinctive symptoms of epiglottitis.

4. Treatment.
   a. Humidified oxygen.
   b. Antibiotics
   c. Endotracheal intubation for obstruction (see Appendix 10-5).
B. Acute laryngotracheobronchitis (croup): inflammation of the vocal cords, subglottal tissue, trachea, bronchi. most often in children ages 6 mo to 5 years.
1. Onset over several days, frequently preceded by upper respiratory tract infection.
2. Respiratory distress (see Table 10-3).
   a. Inspiratory stridor when disturbed, progressing to continuous stridor.
   b. Flaring of nares, use of accessory muscles of respiration.
   c. “Seal bark” cough is classic sign.
3. Low-grade fever (usually below 102° F).
4. Signs of impending obstruction.
   a. Retractions (intercostals, suprasternal, and substernal) at rest.
   b. Increased anxiety and restlessness
   c. Tachypnea (rate may be above 60 breaths/min).
   d. Pallor and diaphoresis
   e. Nasal flaring.

TEST ALERT: Implement measures to prevent to manage/prevent possible complication of client condition or procedure, intervene to improve client respiratory status by giving a breathing or respiratory treatment, suctioning, or repositioning; notify health care provider of a change in client’s condition.

5. Treatment.
   a. Cool mist humidification.
   b. Oxygen.
   c. IV fluids if child cannot maintain PO intake.
   d. Maintain patent airway.
   e. Bronchodilators, racemic epinephrine (for moderate to severe croup) by inhalation.
   f. Cool mist humidification.
   g. No sedatives.
   h. Oxygen.
   i. Corticosteroids, administered intravenously, intramuscularly, or orally.

Nursing Interventions

❖ Goal: To maintain patent airway in hospitalized child.
A. Tracheotomy set or endotracheal intubation equipment easily available.

❖ NURSING PRIORITY: Do not examine the throat of a child with epiglottitis, it may precipitate an airway spasm (laryngospasm).

B. Endotracheal tube or tracheotomy – suction airway only as necessary.
C. Position for comfort; do not force child to lie down.
D. If child is intubated or in severe distress, do not leave unattended.
E. If transport is required, allow the child to sit upright in parent’s lap if possible.

❖ Goal: To evaluate and maintain adequate ventilation.
A. Assess for increasing hypoxia.
B. Maintain child in humidified O₂.
C. Conserve energy; promote rest and prevent crying.
D. Monitor pulse oximetry for adequate oxygenation.
E. Report symptoms of increasing respiratory difficulty.

❖ NURSING PRIORITY: Early signs of impending airway obstruction are the same as early signs of hypoxia (Table 10-3).

❖ Goal: To maintain hydration and nutrition.
A. Do not give oral fluids until danger of aspiration is past.

❖ NURSING PRIORITY: In children with severe respiratory distress (rate above 60), do not give anything by mouth due to increased risk for aspiration.

B. Monitor IV fluids during acute episodes.
C. Provide high-calorie liquids when danger of aspiration is over.
D. Suction nares of infant before feeding.
E. Assess for adequate hydration.

Home Care
A. Teach parents to recognize symptoms of increasing respiratory problems and when to notify physician.
B. Cool mist may assist to decrease edema and/or spasms of airway.
C. Maintain adequate fluid intake.
D. Immunization with H. Influenza type B vaccine.
Respiratory Syncytial Virus
(Bronchiolitis)

A. Respiratory syncytial virus (RSV) is most common cause of bronchitis and lower respiratory tract infections in infants and young children.
B. RSV is transmitted by direct contact with respiratory secretions (Appendix 5-9).

Data Collection
A. Cause: usually begins after an upper respiratory tract infection; incubation period of 5-8 days.
B. Reinfection is common; severity tends to decrease with age and repeated infections.
C. Clinical manifestations.
   1. Initial.
      a. Rhinorrhea with copious amounts of secretions.
      b. Low-grade fever, coughing, wheezing
   2. Acute phase.
      a. Lethargic.
      b. Tachypnea, air hunger, retractions.
      c. Increased wheezing and coughing.
      d. Periods of apnea, poor air exchange
D. Diagnostics: nasal secretions for RSV antigens.

Treatment
A. Rest, fluids, and high-humidity environment.
B. O₂.
C. Prevention – medication (see Appendix 10-2).

Nursing Interventions
❖ Goal: To promote effective breathing patterns.
A. Frequent assessment for development of hypoxia (see Box 10-3); close monitoring of O₂ saturation (oximetry) levels.
B. Increase in respiratory rate and audible crackles in the lungs are indications of cardiac failure and should be reported immediately.
C. Maintain airway via position and removal of secretions.
D. Maintain adequate hydration to facilitate removal of respiratory secretions.
E. Respiratory and nasal secretions make it difficult for an infant to bottle feed or to nurse; instill normal saline drops and suction prior to feeding.
F. Conserve energy; avoid unnecessary procedures, but encourage parents to console and cuddle infant.
❖ Goal: To prevent transmission of organisms.
A. If hospitalized, the child should be placed in a private room, with contact/standard precautions in place (Appendix 5-9).
B. Decrease number of health care personnel in client’s room.
C. Nurses assigned to care for these children should not be assigned the care of other children who are at high risk for respiratory tract infections.

Home Care
A. Decreased energy level; will tire easily.
B. Small frequent feedings, normal saline nose drops prior to feeding.
C. Teach parents how to assess for respiratory difficulty and to report any signs of respiratory difficulty – paroxysmal cough, dyspnea, increased respiratory secretions.

Tonsillitis
❖ Tonsillitis is an inflammation and infection of the palatine tonsils.

Data Collection
A. Risk factors/etiology.
   1. More common in children, increased severity in adults.
   2. Generally peaks in winter
B. Clinical manifestations.
   1. Edematous, enlarged tonsils; exudate on tonsils.
   2. Difficulty swallowing and breathing.
   3. Frequently precipitates otitis media.
   4. Mouth breathing.
   5. Persistent cough, fever.
C. Diagnostics: throat culture for group A beta-hemolytic streptococci.

Treatment
A. Antibiotic for identified organism.
B. Surgery: tonsillectomy for severe repeated episodes of tonsillitis.

Nursing Interventions
❖ Goal: To assist parents to understand disease process and to promote comfort and healing in home environment.
A. Soft or liquid nonirritating diet.
B. Cool mist vaporizer to maintain moisture in mucous membranes.
C. Throat lozenges, warm gargles to soothe the throat.
D. Explain to parents the importance of giving the child all the medication prescribed in order to prevent reoccurrence.
E. Analgesics, antipyretic (acetaminophen).
❖ Goal: To provide preoperative nursing measures if surgery is indicated (see Chapter 3).
❖ Goal: To maintain patent airway and evaluate for bleeding after tonsillectomy.
A. No fluids until child is fully awake; then cool, clear liquids initially. Avoid brown- or red-colored fluids and milk products.
B. Position child on side or abdomen to facilitate drainage until fully awake; when awake and alert, child may assume position of comfort but should remain in bed for the day.
C. Evaluate for frequent or continuous swallowing, tachycardia and pallor caused by bleeding; check throat with a flashlight.
D. Have nasopharyngeal suction equipment available.
E. Apply ice collar to decrease edema.
F. Discourage coughing.

✓ NURSING PRIORITY: Before the child is fully awake, position him or her on side or abdomen to prevent aspiration from bloody drainage or vomitus. Always consider the client who has had a tonsillectomy to be nauseated as a result of swallowing blood.

Home Care
A. Child will have sore throat for several days; discourage coughing and excessive activity.
B. Bleeding may occur on the 5th to 10th postoperative days, when tissue sloughing may occur as a result of healing and/or infection.
C. Maintain adequate hydration; encourage intake of soft feeds and nonirritating fluids.
D. A gray membrane on the sides of the throat is normal; should disappear in 1 to 2 weeks.

Pneumonia
* Pneumonia is an acute inflammatory process caused by a microbial agent; it involves the lung parenchyma, including the small airways and alveoli. (Figure 10-3)

Data Collection
A. Predisposing conditions.
   1. Chronic upper respiratory tract infection.
   2. Postoperative
   3. Prolonged immobility.
   4. Smoking.
   5. Decreased immune state (disease and/or age).
   6. Aspiration of foreign material or gastric contents.
B. Clinical manifestations.
   1. Fever, chills, tachycardia.
   2. Tachypnea, dyspnea.
   5. Malaise, altered mental status.
   6. Respiratory distress (hypoxia) (see Table 10-3).
   7. Diminished breath sounds.
C. Diagnostics: see Appendix 10-1.

✓ OLDER ADULT PRIORITY: An older adult client may initially present with mental confusion and volume depletion rather than respiratory symptoms and fever.

Treatment
A. Antibiotic according to organism identified (see Appendix 5-10).

✓ NURSING PRIORITY: Do not start antibiotics until a good sputum specimen has been collected. An accurate culture and sensitivity test cannot be done if client has already begun receiving antibiotics.

B. Respiratory precautions: transmitted via airborne droplets (see Appendix 5-9).
C. Inhalation therapy.
   1. Cool O₂ mist.
   2. Postural drainage.
D. Chest physical therapy.

Nursing Interventions
★ Goal: To prevent occurrence.
A. Encourage mobility and ambulation as soon as possible.
B. Good respiratory hygiene; turn, cough, and deep-breathe.
C. Identify high-risk clients.
D. Encourage pneumococcal vaccine.
★ Goal: To decrease infection and remove secretions to facilitate O₂ and CO₂ exchange.
A. Antibiotics.
B. Assist/encourage client to turn, cough, and deep-breathe.
C. Liquefy secretions.
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1. Adequate hydration (administer PO fluids cautiously to prevent aspiration).
2. Cool mist inhalation.
D. Evaluate breath sounds and changes in sputum.
E. Position for comfort or semi-Fowler’s position.
F. Nursing measures to prevent and evaluate levels of hypoxia (see Hypoxia, Nursing Interventions; also see Table 10-3).
G. Provide adequate pain control measures to facilitate coughing and deep breathing.
H. Droplet/contact with standard precautions, based on identified organism and transmission.

Goal: To teach client and family how to provide home care when appropriate.
A. Antibiotics.
B. Cool mist humidification.
C. Maintain high oral fluid intake.
D. Antipyretic: acetaminophen.
E. Encourage activity.
F. Return to primary care provider:
   1. Return or increase in fever and chills.
   2. Chest pain, hemoptysis.
   3. Increase in difficulty breathing.

Tuberculosis

* TB is a reportable communicable disease that is characterized by pulmonary manifestations.

A. Characteristics.
   1. Organism is primarily transmitted through respiratory droplets; it is inhaled and implants on respiratory bronchioles or alveoli; predominately spread by repeated close contact.
   2. Characteristic tissue reaction is the formation of a tubercle in the lung, the primary site or tubercle may undergo a process of degeneration or caseation; this area can erode into the bronchial tree, and TB organisms are active and present in the sputum, resulting in further spread of the disease.
   3. The tubercle may never erode but may calcify and remain dormant after the primary infection. However, the tubercle may contain living organisms that can be reactivated several years later.
   4. The majority of people with a primary infection harbor the TB bacilli in a tubercle in the lungs and will not exhibit any symptoms of an active infection.
   5. May occur as an opportunistic infection in clients who are immunocompromised.

Data Collection

A. Predisposing conditions.
   1. Frequent close or prolonged contact with infected individual, who frequently has not been diagnosed.
   2. Debilitating conditions and diseases.
   3. Poor nutrition and crowded living conditions.

B. Cause: Mycobacterium tuberculosis, a gram-positive, acid-fast bacillus.
C. Clinical manifestations (up to 20% of clients may be asymptomatic).
   1. Fatigue, malaise.
   2. Anorexia, weight loss.
   3. May have a chronic cough that progresses to more frequent and productive cough.
   4. Low-grade fever and night sweats.
   5. Hemoptysis is associated only with advanced condition.
   6. May present with acute symptoms.

D. Diagnostics (see Appendix 10-1).

✔ NURSING PRIORITY: A positive reaction to a TB skin test means that the person has at some time been infected with the TB bacillus and developed antibodies. It does not mean that the person has an active TB infection.

   1. QuantiFERON-TB (QFT) rapid diagnostic: blood test to identify presence of antigens; does not take the place of sputum smears and cultures.
   2. Bacteriologic studies to identify acid-fast bacilli in the sputum.

E. Complications.
   1. Pleural effusion.
   2. Pneumonia.
   3. Other organ involvement.

Treatment

A. Chemotherapy (see Appendix 10-2).
   1. Medical regimen involves simultaneous administration of two or more medications; this increases the therapeutic effect of medication and decreases development of resistant bacteria.
   2. Sputum cultures are evaluated every 2-4 weeks initially; then monthly after sputum is negative. Sputum cultures should be negative within several weeks of beginning therapy, this depends on the medication regimen and the resistance of the bacteria.
   3. Direct observed therapy (DOT): health care personnel provide the medications and observe that client swallows medication; preferred strategy for all clients.
   4. Prophylaxis chemotherapy
      a. Close contact with a client with a new diagnosis of TB.
      b. Newly infected client with positive skin test reaction.
      c. Client has a positive skin test reaction and is immunocompromised.
      d. Isoniazid (INH) most often used for prophylaxis.

B. Most often treated on an outpatient basis.
Nursing Interventions

- **Goal:** To understand implications of the disease and measures to protect others and maintain own health.
  - A. Evaluate client’s lifestyle and identify needs regarding compliance with treatment and long-term therapy.
  - B. Identify community resources available for client.
  - C. Understand medication schedule and importance of maintaining medication regimen.
    1. Noncompliance is a major contributor to the development of multidrug resistance and treatment failure.
    2. DOT recommended to guarantee compliance; may require client to come to public health clinic for nurse to administer medication.
  - D. Return for sputum checks every 2 to 4 weeks during therapy.
  - E. Balanced diet, supplemental vitamins, good hydration.
  - F. Avoid excessive fatigue; endurance will increase with treatment.
  - G. Identify family and close contacts who need to report to the public health department for TB screening.
  - H. Offer client HIV testing.
- **Goal:** To prevent transmission of the disease.
  - A. When sputum is positive for the organism, implement airborne precautions for hospitalized client (see Appendix 5-9).

**TEST ALERT:** Implement standard precautions; apply infection control measures; use correct equipment to prevent environmental spread of infection.

- B. Home care: teach respiratory precautions.
  1. Cover mouth and nose when sneezing or coughing (Appendix 5-9).
  2. Practice good hand hygiene.
  3. Wear a mask when in contact with other people.
  4. Discard all secretions (nose and mouth) in plastic bags.
  5. Reevaluate periodically for active disease or secondary infection.

Chronic Obstructive Pulmonary Disease

* Chronic obstructive pulmonary disease (COPD) is a group of chronic respiratory disorders characterized by obstruction of airflow.

**Assessment**

- A. Risk factors/etiology.
  1. Cigarette smoking (including passive smoking)—most common cause.
  2. Chronic infections.
  3. Inhaled irritants (from occupational exposure and air pollution).

- B. Clinical manifestations (Figure 10-4).
  1. Distended neck veins, ankle edema.
  2. Orthopnea or tripod positioning, barrel chest.
  3. Prolonged expiratory time, pursed-lip breathing.
  4. Diminished breath sounds.
  5. Thorax is hyperresonant to percussion.
  6. Exertional dyspnea progressing to dyspnea at rest.
  7. Increased respiratory rate.
  8. As a result of a prolonged increase in PaCO₂ levels, the normal respiratory center in the medulla is affected; when this occurs, hypoxia will become the primary respiratory stimulus.
  9. Emphysema
    a. Cough is not common.
    b. Sensation of air hunger.
    c. Use of accessory muscles of respiration.
    d. Anorexia with weight loss, thin in appearance.
    e. ABGs are often normal until late in disease.
    f. Characteristic tripod position—leaning forward with arms braced on knees.
  10. Chronic bronchitis:
    a. Excessive, chronic sputum production (generally not discolored unless infection is present).
    b. Impaired ventilation, resulting in decreased PaO₂ and symptoms of hypoxia; increased PaCO₂ (CO₂ narcosis).
    c. Respiratory symptoms: productive cough, exercise intolerance, wheezing, and shortness of breath, progressing to cyanosis.
    d. Dependent edema.
    e. Cardiac enlargement with cor pulmonale.

- C. Diagnostics: see Appendix 10-1.

- D. Complications.
1. Cor pulmonale (right-side heart failure).
2. Infections (pneumonia).
3. Peptic ulcer and gastroesophageal reflux (GERD; see Chapter 13).

**Treatment**

A. Prevention or treatment of respiratory tract infections.
B. Bronchodilators (see Appendix 10-2).
C. Mucolytics and expectorants (see Appendix 10-2).
D. Chest physiotherapy (suctioning, percussion, and postural drainage).
E. Breathing exercises.
F. Exercise to maintain cardiovascular fitness; most common exercise is walking.
G. Low-flow humidified O\(_2\).
H. Corticosteroids (see Appendix 5-7).

**NURSING PRIORITY:** The optimum amount of O\(_2\) is the concentration that reverses the hypoxemia without causing adverse side effects. Always notify the RN or health care provider if it is necessary to increase the flow of O\(_2\) for clients with COPD.

**Nursing Interventions**

- **Goal:** To improve ventilation.
  A. Assist client to balance activities and increasing dyspnea.
     1. Teach pursed-lip breathing: inhale through the nose and exhale against pursed lips.
     2. Schedule activities or exercise after respiratory therapy.
     3. Assess for negative responses to activity – increasing dyspnea, tachycardia.
     4. Use portable O\(_2\) tank when walking or exercising.
     5. Avoid respiratory irritants.
  B. Humidified O\(_2\) (low flow via nasal cannula at a rate of 1 to 3 L/min) should be used when clients are experiencing exertional or resting dyspnea.
     1. Monitor for increased levels of PaCO\(_2\), hypoxia, and respiratory acidosis.
     2. A significant increase in Pao2 may decrease respiratory drive (O\(_2\) toxicity).
     3. Administer O\(_2\) via nasal cannula or Venturi mask (to deliver a more precise Fio\(_2\)).
     4. Assess for pressure ulcers on the top of the client’s ears where the elastic holds the mask.

- **Goal:** To maintain adequate nutrition.
  A. Soft, high-protein, high-calorie diet—especially for underweight clients.
  B. Postural drainage completed 30 minutes before meals or 3 hours after meals.
  C. Good oral hygiene after postural drainage.
  D. Small frequent meals; rest before and after meals.
  E. Use a bronchodilator before meals.
  F. Encourage 3000 mL fluid daily unless contraindicated.

**Home Care**

A. Encourage client and family to verbalize feelings about condition and lifelong restriction of activities.
B. Include client in active planning for home care.
C. Discuss with client medication schedule and side effects of prescribed medications.
D. Review with family and client signs and symptoms of upper respiratory tract infection and know when to call physician.
   1. Changes in sputum color – yellow, green, or blood tinged.
   2. Increasing levels of dyspnea.
   3. Fever
E. Encourage activities such as walking—an increase in respiratory rate and shortness of breath will occur, but if respirations return to normal within 5 minutes of stopping activity, it is considered normal.

**Asthma**

- Asthma is an intermittent, reversible obstructive airway problem. It is characterized by exacerbations and remissions. Between attacks the client is generally asymptomatic. It is a common disorder of childhood but may also cause problems throughout adult life.

A. Intermittent narrowing of the airway caused by:
   1. Constriction of the smooth muscles of the bronchi and the bronchioles (bronchospasm).
   2. Excessive mucus production.
   3. Mucosal edema of the respiratory tract.
B. Exercise-induced asthma: initially after exercise there is an improvement in the respiratory status, followed by a significant decline; occurs in the majority of clients;
may be worse in cold, dry air and better in warm, moist air.

C. Emotional factors are known to play a role in precipitating childhood asthma attacks.

**Data Collection**

A. Risk factors/etiology.
   1. Hypersensitivity (allergens) and airway inflammation.
   2. Air pollutants and occupational factors.
   3. Pediatric implications.
      a. Reactive airway disease is the term used to describe asthma in children.
      b. General onset before age 3 years.
      c. Children are more likely to have airway obstruction.

B. Diagnostics: see Appendix 10-1.

C. Clinical manifestations:
   1. Episodic wheezing, chest tightness, shortness of breath, cough – in absence of infection.
   2. Use of accessory muscles in breathing, orthopnea.
   3. Symptoms of hypoxia (see Table 10-3); cyanosis occurs late.
   4. Increased anxiety, restlessness.
   5. Difficulty speaking.
   6. Thick tenacious sputum.
   7. Diaphoresis.

**NURSING PRIORITY:** Shortness of breath, increase in respiratory rate and decreased breath sounds are highly suggestive of respiratory failure and possibly impending respiratory obstruction – the nurse should seek immediate assistance and anticipate ventilatory support and possible endotracheal intubation.

D. Complications: status asthmaticus is severe asthma unresponsive to initial or conventional treatment; the practical nurse should notify the RN if a client does not respond to initial treatment with bronchodilators.

**Treatment**

A. Medications (see Appendix 10-2).
   1. Bronchodilator.
   2. Expectorants.
   3. Inhaled steroids and anti-inflammatory drugs to prevent and/or decrease edema.

B. Supplemental humidified O₂ to maintain SₐO₂ above 90%.

**Nursing Interventions**

See Hypoxia, Nursing Interventions.

**Goal:** To relieve asthma attacks.

A. Position for comfort: usually high-Fowler’s position or tripod position.

**Cystic Fibrosis**

Cystic fibrosis is a chromosomal abnormality characterized by a generalized dysfunction of the exocrine glands. The disease primarily affects the lungs, pancreas, and sweat glands. The factor responsible for the multiple clinical manifestations of the disease process is the mechanical obstruction caused by thick mucus secretions.

A. Organs affected by disease process.
   1. Pulmonary system: bronchial and bronchiolar obstruction by thick mucus, causing atelectasis and reduced area for gas exchange; the thick mucus provides an excellent medium for bacterial growth and secondary respiratory tract infections.
   2. Pancreas: Obstruction of the pancreatic ducts result in a decreased excretion of pancreatic enzymes necessary for normal digestion and absorption of nutrients.

B. Condition is diagnosed in early childhood; with effective treatment, many CF clients are adults and lead active lives.
Data Collection
A. Risk factors/etiology: inherited as an autosomal recessive trait.
B. Clinical manifestations.
   1. Wide variation in severity and extent of manifestations, as well as period of onset.
   2. Gastrointestinal tract.
      a. Steatorrhea or fatty foul-smelling stools.
      b. Increased bulk in feces from undigested foods; rectal prolapse may occur in infants.
      c. Meconium ileus may occur in newborn.
      d. Abdominal distention.
   3. Respiratory tract.
      a. Evidence of respiratory tract involvement generally occurs in early childhood.
      b. Increasing dyspnea, tachypnea.
      c. Paroxysmal, chronic cough.
      d. Pulmonary inflammation: chronic bronchitis.
      e. Increasing problems with hypoxia.
      f. Mucus provides excellent medium for bacteria growth and chronic infections.
   4. Excessive salt on the skin: “salty taste when kissed.”
C. Diagnostics: see Appendix 10-1.
   1. Sweat chloride test: normal chloride concentration range is less than 40 mEq/L, with a mean of 18 mEq/L; chloride concentration 40-60 mEq/L is suggestive of a diagnosis of cystic fibrosis.
   2. Pancreatic enzymes: decrease or absence of trypsin and chymotrypsin.
   3. Fat absorption in intestines is impaired.
D. Complications.
   1. Cor pulmonale and respiratory failure are late complications.
   2. Frequent pulmonary infections.
   3. Pneumothorax.
   4. Glucose intolerance secondary to destruction of pancreatic tissue.

Treatment
Child is usually cared for at home unless complications are present.
A. Nutrition
   1. Diet that is high-calorie, high-protein, fats as tolerated; or decrease in fats, increased salt intake.
   3. Pancreatic enzyme replacement with meals, or with any intake of high fat food. (see Appendix 8-2).
D. Pulmonary therapy.
   1. Physical therapy: postural drainage, breathing exercises.
   2. Aerosol therapy and chest physical therapy (CPT)
   3. Percussion and vibration.
   4. Expectorants (see Appendix 10-2).
E. Antibiotics are given prophylactically and when there is evidence of infection.

Nursing Interventions
✦ Goal: To prevent or minimize pulmonary complications.
A. Assist child to mobilize secretions.
   1. CPT: postural drainage, breathing exercises, nebulization treatments.
   2. Encourage active exercises appropriate to child’s capacity and developmental level.
B. Prevent respiratory tract infections.
C. Prevent pneumothorax: no power lifting, intensive isometric exercises, scuba diving.
D. Maintain good fluid intake to promote removal of secretions.
✦ Goal: To maintain good nutrition.
A. Balanced diet for all food groups with decrease in fat.
B. Perform good oral hygiene before each meal.
C. Administer pancreatic enzymes immediately prior to eating.
D. Perform postural drainage at least 2 hours prior to meals.
✦ Goal: Promote optimum home care for child (see Chapter 3 for care of chronically ill child).
A. When appropriate, teach child about heredity aspect of disease.
B. Promote independence in client’s ADL’s.
   1. Encourage children to be responsible for own medications and treatments.
   2. Teach children how to avoid respiratory infections at school.
   3. Encourage parents to promote child’s active involvement in planning and implementing health care routines.
C. Encourage exercises appropriate to child’s capacity and developmental level.

Pulmonary Edema
* This condition is caused by an abnormal accumulation of fluid in the lung in both the interstitial and alveolar spaces.

A. Pressure builds up in the pulmonary circulation secondary to failure of the left ventricle to pump adequately.
B. The severe impairment of the left ventricle to pump effectively and to maintain cardiac output results in an increase in pressure in the pulmonary circulation and movement of fluid into the interstitial spaces and the alveoli of the lung.

Data Collection
A. Risk factors/etiology.
   1. Overhydration of IV fluids, especially in older adult clients with cardiac problems.
   2. Heart Failure
B. Clinical manifestations: hypoxia (see Table 10-3).
   1. Decreasing $\text{SpO}_2$ and $\text{PaO}_2$. 

Pulmonary Edema
This condition is caused by an abnormal accumulation of fluid in the lung in both the interstitial and alveolar spaces.
2. Onset of dyspnea may be sudden or gradual.
3. Severe anxiety, restlessness, irritability.
4. Cool, moist skin.
5. Tachycardia (S3, S4 gallop)/tachypnea.
6. Severe coughing productive of frothy, blood-tinged sputum.
7. Noisy, wet breath sounds that do not clear with coughing.

**OLDER ADULT PRIORITY: Pulmonary edema can occur very rapidly and become a medical emergency.**

C. Diagnostics: B-type natriuretic peptide (BNP, Appendix 12-1).

**Treatment**

Condition demands immediate attention; medications are administered intravenously.

A. O₂ in high concentration.
B. Intubation and mechanical ventilation.
C. Rapid acting diuretics, may need to place a urinary retention catheter.
D. Pulmonary therapy - bilevel positive airway pressure (BiPAP).
E. Medications to increase cardiac contractility and cardiac output (see Appendix 10-2).

**Nursing Interventions**

- **Goal:** To assess and decrease hypoxia (see Hypoxia, Nursing Interventions; also Table 10-3).
- **Goal:** To improve ventilation
  A. Place in high-Fowler’s position with legs dependent.
  B. Administer high levels of O₂ (Appendix 10-7).
  C. Evaluate level of hypoxia and dyspnea; may need endotracheal tube intubation and mechanical ventilation (Appendix 10-5, 10-9).
  D. Use caution when suctioning client, prolonged suctioning will decrease the PaO₂.
  E. Problem may occur at night, especially in clients who are on bed rest.
  F. RN may administer IV sedatives/narcotics.
     1. To decrease anxiety and dyspnea and to decrease pressure in pulmonary capillary bed.
     2. Closely observe for respiratory depression.
  G. Administer bronchodilators and evaluate client’s response.
  H. Closely monitor vital signs, pulse oximetry, hemodynamic changes, and cardiac dysrhythmias.
- **Goal:** To reduce circulating volume (preload) and cardiac workload (afterload).

**OLDER ADULT PRIORITY: Increased fluid intake in older clients may precipitate a cardiac overload; closely observe clients who are receiving blood and IV fluids.**

A. Administer diuretics to decrease circulating volume (see Appendix 11-5).
B. Medications to decrease cardiac workload and increase cardiac output (see Appendix 12-2).
C. Carefully monitor all IV fluids and continuously evaluate tolerance.
D. Maintain client in semi- to high Fowler’s position, but allow legs to remain dependent.

- **Goal:** To provide psychological support and decrease anxiety.
  A. Approach client in a calm manner.
  B. Explain procedures.
  C. Remain with client in acute respiratory distress.
- **Goal:** To prevent recurrence of problem.
  A. Recognize early stages of the problem.
  B. Maintain client in semi-Fowler’s position.
  C. Decrease levels of activity.
  D. Use extreme caution in administration of fluids and transfusions.
  E. Monitor daily weights and assess weight gain and fluid balance.

**Cancer of the Larynx**

- May involve the vocal cords or other areas of the larynx. If detected early, this type of cancer is curable by surgical resection of the lesion. (see Chapter 2).

**Data Collection**

A. Risk factors/etiology.
   1. More common in older adult men.
   2. History of tobacco use.
B. Clinical manifestations (may be asymptomatic)
   1. Early changes.
      a. Voice changes, hoarseness.
      b. Persistent unilateral sore throat, difficulty swallowing.
      c. Feeling of foreign body in throat.
   2. Late changes.
      a. Pain.
      b. Dysphagia and decreased tongue mobility.
      c. Airway compromise.
C. Diagnostics: direct laryngoscopic examination with biopsy.

**Treatment**

Based on the extent of the malignancy, and the client choice of therapy.

A. Radiation: brachytherapy—placing a radioactive source into or near the area of the tumor; may also be used with external radiation treatments (see Chapter 2).
B. Surgical intervention.
   1. Partial laryngectomy: preserves the normal airway and normal speech mechanism; if a trache-
ototomy is performed, it is removed after the risk for swelling and airway obstruction has subsided.

2. Radical neck dissection or total laryngectomy, involves resection of the trachea, a permanent tracheotomy for breathing, and an alternative method of speaking (Appendix 10-5).

Complications
A. Airway obstruction.
B. Hemorrhage.
C. Fistula formation.

Nursing Interventions

 Goal: To prevent oral and laryngeal cancer.
A. Avoid chemical, physical, or thermal trauma to the mouth.
B. Maintain good oral hygiene: regular brushing and flossing.
C. Prevent constant irritation in the mouth; repair dentures or other dental problems.
D. See a doctor for any oral lesion that does not heal in 2 to 3 weeks.

 Goal: To prepare client for surgery.
A. General preoperative preparation (see Chapter 3).
B. The surgeon should discuss with the client the method of postoperative airway management – permanent or temporary tracheotomy.
C. Plan follow up discussion with client regarding type of tracheotomy anticipated.
D. Encourage ventilation of feelings regarding a temporary or permanent loss of voice after surgery, as well as alteration in physical appearance.
E. If total laryngectomy is anticipated, a visit from a speech pathologist to discuss postoperative speech may be helpful in reducing anxiety.
F. Establish a method of communication for immediate postoperative period.
G. With a permanent tracheotomy, there will be a loss or significant reduction in the ability to smell.

 Goal: To prevent aspiration and maintain a patent airway.
A. If tracheotomy is not performed, evaluate for hematoma and increasing edema of the incisional area that can precipitate airway occlusion respiratory distress.
B. Place in semi-Fowler’s position.
C. Administer humidified O₂ therapy.
D. Observe for signs and symptoms of hypoxia.
E. Avoid analgesics that depress respiration.
F. Promote good pulmonary hygiene.
G. If tracheotomy is present, suction as indicated (see Appendix 10-6).

 Goal: To maintain airway; to prevent complications after tracheotomy (see Appendix 10-5).

 Goal: To promote nutrition postoperatively.
A. Method of nutritional intake depends on the extent of the surgical procedure (see Appendix 13-6 for tube feedings).
B. IV fluids initially.
C. Gastrostomy, nasogastric, or nasointestinal tubes may be placed during surgery and used until edema has subsided and incisional area begins to heal.
D. Provide good oral hygiene; may need to suction oral cavity if client cannot swallow.
E. Evaluate tolerance of tube feedings; treat nausea quickly to prevent vomiting (see Appendix 13-6).
F. Closely observe for swallowing difficulty with initial oral feedings.

 Goal: To promote wound healing.
A. Assess pressure dressings and presence of edema formation.
B. Monitor wound suction devices (Hemovac, Jackson-Pratt) drainage should be serosanguineous.
C. Monitor patency of drainage tubes every 3-4 hours, fluid should gradually decrease.
D. If skin flaps were used, the wound is often left uncovered for better visualization of flap and to prevent pressure on area.
E. When drainage tubes are removed, carefully observe area for increased swelling.

Home Care (total laryngectomy with permanent tracheotomy)

 TEST ALERT: Identify significant body image change that may affect recovery; monitor client progress toward achieving improved body image (see Chapter 6).

A. Encourage client to begin own suctioning and caring for the tracheostomy before he or she leaves the hospital.
B. Assist the family in obtaining equipment for home use.
1. System for humidification of air in home environment.
2. Suction and equipment necessary for tracheostomy care.
C. Care of stoma.
1. No swimming.
2. Wear plastic collar over stoma while showering.
3. Maintain high humidification at night to increase moisture in airway.
4. Avoid use of aerosol sprays.
D. Nutritional considerations: client cannot smell; taste will also be affected.
E. Client should carry medical identification.
F. Encourage client to put arm and shoulder on affected side through range of motion exercises to prevent functional disabilities of the shoulder and neck.

Cancer of the Lung

* Cancer of the lung is a tumor arising from within the lung. It may represent the primary site or may be a metastatic site from a primary lesion elsewhere (see Chapter 2).

Data Collection

A. Risk factors.
   1. Smoking, including passive smoking.
   2. Occupational exposure to and/or inhalation of carcinogens.
B. Clinical manifestations: nonspecific; appear late in disease.
   1. Persistent chronic cough.
   2. Change in respiratory pattern – wheezing or dyspnea.
   3. Hemothysis or blood streaked sputum.
      a. Liver, bones, brain.
      b. Lymph nodes: mediastinum.
   5. Pain is a late manifestation.
C. Diagnostics: bronchoscopy with biopsy.

Treatment

Varies with the extent of the malignancy (see Chapter 2).
A. Radiation: may be used preoperatively to reduce tumor mass.
B. Surgery: treatment of choice early in condition.
   1. Lobectomy: removal of one lobe of the lung.
   3. Lung conserving resection: removal of a small area (wedge) or a segment of the lung.
C. Chemotherapy.
D. Treatment may involve all three therapies.
E. Palliative – may include radiation to decrease size of tumor, pain management, and comfort.

Nursing Interventions

Goals:

To prepare client for surgery.
A. General preoperative preparations (see Chapter 3).
B. Improve quality of ventilation before surgery.
   1. No smoking.
   2. Bronchodilators.
   3. Good pulmonary hygiene.
C. Discuss anticipated activities in the immediate postoperative period.
   1. Chest tubes and thoracic incision.
   2. Pain control.
   3. Shoulder exercises to promote mobility.
D. Encourage ventilation of feelings regarding diagnosis and impending surgery.
E. Establish baseline data for comparison after surgery.
F. Orient client to the intensive care unit, if indicated.

Goals:

To maintain patent airway and promote ventilation after thoracotomy.
A. Removal of secretions from airway, either by coughing or suctioning.

B. Have client cough frequently, deep-breathe, and use incentive spirometer.
C. Assess vital signs; closely evaluate changes in vital signs and breath sounds.
D. Closely observe pulse oximetry – report levels that are constantly changing or decreasing; provide supplemental O₂ as indicated.
E. Control pain so that client can take deep breaths and cough.
F. Do not position the client who has undergone a wedge resection or lobe resection on the affected side for extended periods of time; this will hinder the expansion of the lung remaining on that side. If client is in stable condition, place in semi-Fowler’s position to promote optimum ventilation.

✔ **NURSING PRIORITY:** Postoperative positioning of the client who has had thoracic surgery is important to remember, especially the client who has undergone pneumonectomy.

G. If the client who has undergone pneumonectomy experiences increased dyspnea, place him or her in semi-Fowler’s position. If tolerated, positioning on the operative side is recommended to facilitate full expansion of lung on unaffected side.
H. Encourage ambulation as soon as possible.
I. Assess presence if or level of dyspnea at rest and with activity.

J. Maintain water-sealed drainage system (see Appendix 10-4). The client who has undergone pneumonectomy will not have chest tubes for lung reexpansion because there is no lung left in the pleural cavity. Occasionally a chest tube will be placed to remove excessive fluid that collects in the pleural cavity, but not establish negative pressure.

확보: To assess and support cardiac function after thoracotomy.
A. Monitor for dysrhythmias – especially tachycardia.
B. Evaluate urine output.
C. Administer IV fluids and transfusions with extreme caution; client’s condition is very conducive to development of fluid overload.
D. Evaluate hydration and electrolyte status.
E. Report any significant changes in vital signs, activity tolerance, or respiratory status.
F. Encourage shoulder and arm exercises to maintain mobility.

**Home Care**
A. No more smoking; avoid respiratory irritants.
B. Discuss positions that enhance deep breathing and coughing.
C. Decreased strength is common.
D. Continue exercises and activity: stop any activity that causes shortness of breath, chest pain, or undue fatigue.
E. Avoid lifting heavy objects until complete healing has occurred.
F. Return for follow-up care as indicated.
Study Questions: Respiratory System

1. A client is to have a pulse oximetry to measure arterial oxygen levels. How will the nurse explain this procedure to the client?
   1. It will involve deep breathing and blowing into a spirometer.
   2. A probe with a light is placed on the finger to determine oxygen levels.
   3. Arterial blood is drawn to determine the levels of absorbed oxygen.
   4. Medication is inhaled and a pulmonary scan is performed.

2. Clients with pulmonary obstructive disease are usually on low levels of oxygen via nasal cannula. What problem would occur if these clients received too high an oxygen concentration?
   1. Increased sputum production with decreased oxygen exchange.
   2. Respiratory rate greater than 30 breaths per minute.
   3. Decrease in rate and depth of respirations.
   4. Increased wheezing and irritability.

3. A thoracentesis procedure is to be done in the client’s room. The nurse would place the client in which position for this procedure?
   1. Prone position with feet elevated.
   2. Sitting with upper torso over bedside table.
   3. Lying on left side with right knee bent.
   4. Semi-Fowler’s with lower torso flat.

4. What findings would the nurse expect to find in a client who is developing pneumonia as a complication of immobility?
   1. Diminished breath sounds.
   2. Use of accessory respiratory muscles.
   3. Dry hacking cough at night.
   4. Bradypnea and lethargy.

5. An expectorant has been ordered for a client. How will the nurse evaluate the client to determine the effectiveness of the medication?
   1. Decrease in the thickness of the sputum, making it easier to cough up sputum.
   2. Decrease in the amount of mucus by drying the mucous membrane.
   3. Decrease in respiratory rate with a decrease in dyspnea.
   4. Increased depth and quality of respirations.

6. Why should a client with a history of increased blood pressure be cautious about using a decongestant?
   1. May cause a problem with urinary frequency.
   2. Bradycardia is a common untoward effect.
   3. Increases vascular vasoconstriction.
   4. Frequently causes a headache.

7. What assessment findings would indicate a positive response in the client who is being treated for an acute asthmatic problem?
   1. Respiratory rate of 18 breaths per minute.

8. Which of the following clients would be at an increased risk for development of a deep vein thrombosis and potential for pulmonary emboli?
   1. Client in chronic renal failure on hemodialysis.
   2. Client with history of hypertension and current pressure of 180/110.
   3. Older adult client with kyphosis from osteoporosis and respiratory difficulty.
   4. Older adult client who is postoperative after repair of a fractured femur.

9. A client is experiencing progression of his chronic pulmonary condition. What characteristic data would be found on assessment of this client?
   1. Increased temperature and headache.
   2. Hyperventilation and bradycardia.
   3. Increasing dyspnea with cough and fatigue.
   4. Production of sputum and frequent cough.

10. A client’s condition is described as progressing to hypoxemia. How would the nurse interpret this information?
    1. There is an abnormally low level of oxygen in the blood.
    2. Infection has been identified in the blood.
    3. The client’s respirations are greater than 24 breaths per minute.
    4. The client is retaining excessive amounts of carbon dioxide.

11. What is important for the nurse to anticipate in providing care for a client who is 2-days postoperative for a total laryngectomy?
    1. He will have a hoarse voice and difficulty speaking.
    2. The tracheotomy stoma will require cleansing and protection.
    3. He will experience respiratory fatigue with activity.
    4. Hourly suctioning will be required to reduce secretions.

12. A client is 3-days postoperative from a thoracotomy. What would be a normal finding on the nursing evaluation of the chest tube?
    1. Dark drainage with no fluctuation of the fluid in the tubing.
    2. Bubbling in the collection chamber on expiration.
    3. 300 ml daily of serosanguineous drainage.
    4. Moderate amount of bright red drainage in tubing.

13. The nurse auscultates the upper lung fields of a client with asthma and hears wheezing bilaterally. What causes the wheezing sounds?
    1. Tachypnea and bradycardia.
    2. Increased thickness of mucus.
    3. Movement of air through narrowed airways.
    4. The sound of oxygen delivered via nasal cannula.
14. What statement is correct regarding the procedure for suctioning a client with a tracheotomy and increased respiratory secretions?
   1. The catheter is inserted into the tracheotomy tube; intermittent suction is applied until there are no further secretions present.
   2. Suction is applied to the nose and upper airways; then the tracheotomy is suctioned.
   3. With suction applied, the catheter is inserted into the tracheotomy tube until resistance is met; then the catheter is withdrawn.
   4. The catheter is inserted into the tracheotomy until slight resistance is met; suction is applied as the catheter is withdrawn.

15. When transporting a client to the radiology department, how should the nurse provide for the water-sealed chest drainage system?
   1. Hang the drainage apparatus on the head of the bed.
   2. Clamp the chest tube until the client reaches the radiology department.
   3. Keep the collection system below the level of the client’s chest.
   4. Disconnect chest tube from drainage collection chamber.

16. What would create an increased risk of pulmonary infection in the client with chronic pulmonary disease?
   1. Fluid imbalance with pitting edema.
   2. Pooling of respiratory secretions.
   3. Increase in anterior-posterior chest diameter.
   4. Decreased activity and dehydration.

17. The nurse is assigned to work with a client with active tuberculosis. What assessment findings would the nurse anticipate to be present?
   1. Cough, low-grade fever, night sweats.
   2. Tachycardia, oliguria, night sweats.
   3. Upper body rash, night sweats, coughing.
   4. Dyspnea, pleural edema, lack of appetite.

18. A client had a Mantoux skin test; 72 hours later the client’s forearm has a raised red area about 16 mm in diameter. What is the correct interpretation of this Mantoux skin test?
   1. A negative skin reaction.
   2. An allergy to the serum.
   3. Active tuberculosis is present.
   4. Positive for exposure to the tubercle bacillus.

19. A client is 1-day postoperative thoracotomy. What nursing observations would indicate the chest tubes are working correctly?
   1. Good bilateral breath sounds; fluctuation of fluid level in drainage tube.
   2. Bubbling in the water-sealed chamber with each expiration.
   3. Bloody drainage in the drainage chamber of the collection device.
   4. No drainage or fluctuation of fluid level in tubing coming from the client.

20. What nursing observation indicates the cuff on an endotracheal tube is leaking?
   1. An increase in peak pressure on the ventilator
   2. Client is able to speak
   3. Increased swallowing efforts by client
   4. Increased crackles (rales) over left lung field

Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.
## Appendix 10-1  PULMONARY DIAGNOSTICS

### X-RAY STUDIES

**Chest X-Ray Film:** An x-ray film of the lungs and chest wall; no specific care is required before or after x-ray study.

### SPUTUM STUDIES (Appendix 10-8)

**Culture and Sensitivity (C&S) Test:** Sputum is obtained to determine the presence of bacteria (culture); also identifies antibiotic that bacteria will be sensitive to. Sputum should be collected prior to beginning antibiotics.

**Acid-Fast Bacilli:** Sputum collection and analysis when tuberculosis (TB) is suspected; morning sputum may contain a higher concentration of organisms.

**Cytologic Exam:** Tumors in pulmonary system may slough cells into the sputum.

### BRONCHOSCOPY

Provides for direct visualization of larynx, trachea, and bronchi; client is generally NPO for 6 hours before the exam; premedication is given for sedative and or amnesia. The client’s upper airway is anesthetized topically.

**Nursing Implications:** Before the test determine if dentures need to be removed. If biopsy is done, assess for bleeding and possible pneumothorax, do not give anything by mouth until the gag reflex returns. After the exam, monitor for the return of gag and cough reflex; maintain client’s NPO status until return of gag reflex.

### PULMONARY FUNCTION STUDIES

**Purpose:** (1) to evaluate pulmonary function; (2) to evaluate response to bronchodilator therapy; (3) to differentiate diagnosis of pulmonary disease; and (4) to determine the cause of dyspnea.

**Nursing Implications:** The test requires client participation, client must be alert and cooperative; client should not be sedated. Study is done in the pulmonary function laboratory; client will be directed to breathe into a cylinder from which a computer interprets and records data in specific values. Client should not smoke (for 12 hours), nurse should determine if bronchodilating medications are to be given or not.

### COMPUTERIZED AXIAL TOMOGRAPHY (CAT Scan) (See Appendix 15-1)

### LUNG SCAN

**(V/Q Scan):** A procedure to determine the integrity of the pulmonary vessels. Particularly useful in the client suspected of having a pulmonary embolus or a ventilation/perfusion problem. A radioactive dye is injected or is inhaled and the specific uptake is recorded. Client is not sedated or on dietary restrictions.

### PULSE OXIMETRY

Measurement is made by placing a sensor on the finger or earlobe; a beam of light passes through the tissue and measures the amount of oxygen-saturated hemoglobin. If probe is placed on the finger, any nail polish should be removed. Provides a method for continuously evaluating the oxygen saturation levels (SpO₂). It is noninvasive, and there are no pre- or postoximetry preparations. Normal range is 95% or higher. SpO₂ levels below 90% are critical and require immediate attention. Oximetry is not valid in clients who are experiencing shock and vasoconstriction.

### PULMONARY ANGIOGRAM

Contrast material is injected into the pulmonary arteries to visualize pulmonary vasculature. Definitive diagnosis for pulmonary emboli. The client should be well hydrated prior to the procedure.

**Contraindications:** (1) dye or shellfish allergies, (2) unstable condition, (3) uncooperative client, (4) pregnancy.

### MAGNETIC RESONANCE IMAGING (MRI) (See Appendix 15-1)

### THORACENTESIS

A needle is inserted into the pleural cavity, fluid and air are removed. May be used for diagnosis as well as for therapeutic purposes.

**Nursing Implications**

1. Explain procedure to client – it is important for the client to remain very still during the procedure.
2. Position client.
   a. Preferably, client should sit on the side of the bed with the arms and head over the bedside table.
   b. If client is unable to assume sitting position, place on affected side with the head of the bed slightly elevated. Area containing fluid collection should be dependent.
3. Closely monitor client’s respiratory status and general appearance during the procedure.
4. Support and reassure the client during the procedure.
5. After the procedure, position the client on his or her side with puncture side up (or in semi-Fowler’s position) and monitor respiratory status and breath sounds for possible development of a pneumothorax.
6. Anticipate a chest x-ray after completion to check for possible pneumothorax.
Appendix 10-1  PULMONARY DIAGNOSTICS—cont’d.

ARterial Blood gas studies (Table 10-2)
Measurement of the pH and partial pressures of dissolved gases (oxygen, carbon dioxide) of the arterial blood; requires approximately 3 mL of arterial blood, obtained through an arterial puncture. Arterial puncture most commonly performed on the radial artery.

Nursing Implications:
1. If client’s oxygen concentration or ventilatory settings have been changed, or if a client has been suctioned, blood should not be drawn for at least 30 minutes.
2. An Allen’s test should be done prior to the arterial puncture to assess adequacy of collateral circulation.
   Allen’s Test: Hold client’s hand, palm up. While occluding both the radial and ulnar arteries, have the client clench and unclench his or her hand several times; the hand will become pale. While continuing to apply pressure to the radial artery, release pressure on ulnar artery. Brisk color return (5-7 seconds) to the hand should occur with the radial artery still occluded. If color does not return, then ulnar artery does not provide adequate blood flow, and cannulation or puncture of radial artery should not be done.
3. Pressure should be maintained at the puncture site for a minimum of 5 minutes, hand should be warm and of good color.

TEST ALERT: Monitor lab values that are deviations from normal arterial blood gases.

Mantoux skin test
Mantoux test, or purified protein derivative (PPD) test, is a method of tuberculin skin testing. PPD is injected intradermally in the forearm. Results are read in 48 to 72 hours. A positive reaction means the individual has been exposed to M. tuberculosis recently or in the past and has developed antibodies (sensitized). It does not determine if client has an active TB infection.

Nursing Implications
1. Intradermal injection: A small (25-gauge) needle is used to inject 0.1 mL of PPD under the skin. The needle is inserted bevel up; a raised area or “wheal” (6-10 mm) will form under the skin.
2. The most common area for injection is the inside surface of the forearm.
3. Do not aspirate; do not massage area.
4. The client should be given specific directions to return, or plans should be made to read the test in 48 to 72 hours.
5. Interpretation: The area of induration (only the part of the reaction that can be felt; induration may not be visible) is measured, it is not the area of erythema or inflammation.
   a. An induration of 5 mm or more is a positive reaction in immunosuppressed clients, IV drug users, and persons who have been recently exposed to active TB.
   b. An induration of 10 mm is a positive reaction for persons who are at increased risk for infection. This includes IV drug users, clients with chronic medical conditions, children under 4 years of age, institutionalized clients, clients in long-term care facilities, and health care workers.
   c. An induration of 15 mm is a positive reaction for members of the general population who do not meet any of the other criteria.
6. A chest x-ray film, prophylactic medication, and medical follow-up are used to determine whether TB is dormant or active or whether the person was exposed and has an adequate immune response. It is also important to determine when and where the person came in contact with the TB bacillus.
### RESPIRATORY MEDICATIONS

**BRONCHODILATORS** - Relax smooth muscle of the bronchi, promoting bronchodilation and reducing airway resistance; also inhibit the release of histamine.

#### General Nursing Implications

- Metered-dose inhalers (MDIs): Hand-held pressurized devices that deliver a measured dose of drug with each “puff.” When two “puffs” are needed, 1 minute should elapse between the two “puffs.” A spacer may be used to increase the delivery of the medication.
- Dry powder inhalers (DPIs) deliver more medication to lungs and do not require coordination as with an MDI; medication is delivered as a dry powder directly to the lungs; 1 minute should elapse between “puffs.”
- Bronchodilators: Beta2 agonists and theophylline are given with caution to the client with cardiac disease, because tachydysrhythmias and chest pain may occur.
- Aerosol delivery systems have fewer side effects and are more effective.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine (Adrenaline): subQ, IV</td>
<td>Headache</td>
<td>1. Do not administer to clients with hypertension or tachydysrhythmias.</td>
</tr>
<tr>
<td>Racemic (nebulized) epinephrine</td>
<td>Dizziness</td>
<td>2. Primarily used to treat acute asthma attacks and anaphylactic reactions.</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>3. With racemic epinephrine, results should be observed in less than 2 hours.</td>
</tr>
<tr>
<td></td>
<td>Tremors</td>
<td>4. High alert medication.</td>
</tr>
<tr>
<td></td>
<td>Dysrhythmias</td>
<td></td>
</tr>
<tr>
<td>Theophylline (Theodur): PO, rectal, IV</td>
<td>Tachycardia</td>
<td>1. Theophylline blood levels should be determined for long-term use; therapeutic levels are between 10 and 20 mcg/mL; levels above 20 mcg/mL are toxic.</td>
</tr>
<tr>
<td>Aminophylline: IV</td>
<td>Hypotension</td>
<td>2. Monitor client with IV administration, it may cause rapid changes in vital signs.</td>
</tr>
<tr>
<td></td>
<td>Nausea/vomiting</td>
<td>3. Considered to be a third-line drug for use with asthma.</td>
</tr>
<tr>
<td></td>
<td>Seizures</td>
<td></td>
</tr>
</tbody>
</table>

**RAPID-ACTING CONTROL**

#### Beta, Agonists

- Albuterol (Proventil, Ventolin): MDI, DPI, PO, aerosol
- Terbutaline (Brethine): aerosol, PO
- Pirbuterol (Maxair): MDI
- Levalbuterol (Xopenex): nebulizer
- Metaproterenol (Alupent): nebulizer, MDI

- Tachycardia, tremors, and angina can occur but are rare with inhaled preparations.
  
  1. Used for short-term relief of acute reversible airway problems.
  2. Not used on continuous basis in absence of symptoms.
  3. Client teaching regarding proper use of MDI and/or DPI.

**ANTICHLINERGICS**

- Ipratropium bromide (Atrovent): nasal spray, inhalation, MDI
  
  - Nasal drying and irritation. Minimal systemic effects.
  1. Nasal spray may be used for clients with allergic rhinitis and asthma.
  2. MDI used to decrease bronchospasm associated with COPD.
  3. Therapeutic effects begin within 30 seconds.

**LONG-ACTING CONTROL**

#### Beta, Agonists

- Salmeterol (Serevent): DPI
  
  - Headache, cough, tremors, dizziness.
  1. Administered two times daily (q 12 hours).
  2. Not used for short-term relief; effects begin slowly and last for up to 12 hours.
  3. Works well with seasonal and exercise-induced asthma.
  4. Prophylactic use decreases number and severity of attacks.
  5. May be used with beta2 agonist.

#### Corticosteroids

- Beclomethasone (Beclovent, Vanceril): MDI
- Triamcinolone acetonide (Azmacort): MDI
- Fluticasone (Flovent): MDI

- Oropharyngeal candidiasis, hoarseness, throat irritation, bad taste, cough, minimal side effects.
  1. Prophylactic use decreases number and severity of attacks.
  2. Prevents bronchoconstriction before exposure to known precipitant (e.g., exercise).
  3. Not for an acute attack.

**Nonsteroidal Antiinflammatory Drugs**

- Cromolyn sodium (Intal): MDI
  
  - Inhalation: cough, dry mouth, throat irritation, and bad taste.
  1. Prophylactic use decreases number and severity of attacks.
  2. Prevents bronchoconstriction before exposure to known precipitant (e.g., exercise).
  3. Not for an acute attack.

- Nedocromil sodium (Tilade): MDI
  
  - Unpleasant taste.
  1. Given to children over 6 years old.
  2. Maximal effects develop within 24 hours.
  3. Does not treat an acute asthmatic attack.
### Appendix 10-2  
RESPIRATORY MEDICATIONS—cont’d.

#### Leukotriene Modifiers
- **Montelukast** *(Singular)*: PO  
  - Headache,  
  - Once daily dose in the evening.
- **Zafirlukast** *(Accolate)*: PO  
  - GI disturbance  
  - Administer within 1 hour before or 2 hours after eating.

#### ANTITUBERCULAR - Broad-spectrum antibiotic specific to TB bacilli.

**General Nursing Implications**
- Client is not contagious when sputum culture is negative for three consecutive cultures.
- Use airborne respiratory precautions when sputum is positive for bacilli.
- Treatment includes combination of medications for about 6 to 8 months.
- Monitor liver function studies for clients receiving combination therapy.
- After initial therapy, medications may be administered once daily or on a twice-weekly schedule.
- Teach clients they should not stop taking the medications when they begin to feel better.
- Advise clients to return to the doctor if they notice any yellowing of the skin or eyes or begin to experience pain or swelling in joints, especially the big toe.
- Medication regimens always contain at least 2 medications to which the infection is sensitive; inadequate treatment is primary cause of increased incidence.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Isoniazid (INH): PO, IM</strong></td>
<td>Peripheral neuritis</td>
<td>1. Administer with (pyridoxine) vitamin B6 to prevent peripheral neuritis.</td>
</tr>
<tr>
<td></td>
<td>Hypersensitivity</td>
<td>2. Primary medication used in prophylactic treatment of TB.</td>
</tr>
<tr>
<td></td>
<td>Hepatotoxicity</td>
<td></td>
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<tr>
<td></td>
<td>Gastric irritation</td>
<td></td>
</tr>
<tr>
<td><strong>Rifampin (Rifadin): PO</strong></td>
<td>Hepatotoxicity—</td>
<td>1. May negate the effectiveness of birth control pills and warfarin.</td>
</tr>
<tr>
<td><strong>Rifapentine (Priftin): PO</strong></td>
<td>Hepatitis</td>
<td>2. May turn body secretions orange: urine, perspiration, tears—can stain soft contacts.</td>
</tr>
<tr>
<td><em>(a derivative of rifampin)</em></td>
<td>Hypersensitivity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gastric upset</td>
<td></td>
</tr>
<tr>
<td><strong>Ethambutol (Myambutol): PO</strong></td>
<td>Optic neuritis</td>
<td>1. Give with food if GI problems occur.</td>
</tr>
<tr>
<td></td>
<td>Allergic reactions—dermatitis, pruritus, Gastric upset</td>
<td>2. Observe for vision changes.</td>
</tr>
<tr>
<td><strong>Pyrazinamide (PZA Pyrazinamide, Tebrazid): PO</strong></td>
<td>Hepatotoxicity</td>
<td>1. May take with food to reduce GI upset.</td>
</tr>
<tr>
<td></td>
<td>Increased uric acid levels</td>
<td>2. Use with caution in pregnancy.</td>
</tr>
<tr>
<td><strong>Rifabutin (Mycobutin): PO</strong></td>
<td>Rash, GI disturbances, Hepatotoxicity</td>
<td></td>
</tr>
</tbody>
</table>

#### NASAL DECONGESTANTS - Produce decongestion by acting on sympathetic nerve endings to produce constriction of dilated arterioles.

- **Phenylephrine hydrochloride** *(Neosynephrine): intranasal spray*  
  - Large dose will cause CNS stimulation, anxiety, insomnia, increased blood pressure, and tachycardia.
  - With intranasal preparations, rebound congestion may occur.
  - Not recommended for children under 6 years old.

**TEST ALERT:** Monitor client’s use of medications—over the counter and home remedies.

- Medications are frequently found in OTC combination decongestants.
- Caution clients with high blood pressure to check with their health care provider before using.

#### ANTIHISTAMINE - Blocks histamine release at H1 receptors (see Appendix 5-13).

#### EXpectorANT - Stimulates removal of respiratory secretions; reduces the viscosity of the mucus.

- **Guaiifenesin (Robitussin, Mucinex): PO**  
  - Nausea  
  - Increase fluid intake for effectiveness.
  - GI upset

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*CNS,* Central nervous system; *GI,* gastrointestinal; *IM,* intramuscularly; *IV,* intravenously; *OTC,* over-the-counter; *PO,* by mouth (orally); *subQ,* subcutaneous.
Appendix 10-3  SUDDEN AIRWAY OBSTRUCTION

✔ NURSING PRIORITY: The procedure to remove airway obstruction is not effective in the child with epiglottitis or sudden airway obstruction caused by inflammation of the upper airways.

Goal: To identify foreign body airway obstruction.

✔ NURSING PRIORITY: If the adult client is coughing forcefully, do not interfere with attempts to cough and expel the foreign body. Do not administer any forceful blows to the back.

1. If the victim can speak or cry, there is probably adequate air exchange.
2. If the victim cannot speak or cry but is conscious, proceed to implement abdominal thrusts to clear the obstructed airway.
3. If the victim is unconscious:
   a. Call for help: dial 911/announce code blue, etc.
   b. Place client supine.
   c. Open airway using head-tilt/chin-lift method.
   d. Observe for presence of foreign body; perform finger sweep and remove if visible.
   e. Maintain open airway; if there is no evidence of breathing, deliver two effective breaths (breaths that cause visible chest rise) either mouth-to-mouth or mouth-to-nose and mouth resuscitation.
   f. If effective breaths cannot be delivered, reposition head, reopen airway, and attempt to ventilate victim again.
   g. If still unable to ventilate, initiate procedure for relieving obstructed airway.

TEST ALERT: Identify and intervene in life-threatening situations; evaluate and document client’s response to emergency procedures.

Goal: To clear obstructed airway—adult and child (conscious and unconscious).

1. Conscious: Perform Heimlich (abdominal thrusts) maneuver (chest thrusts if pregnant or obese) until obstruction is removed or client becomes unconscious.
   a. Stand behind client and wrap arms around waist.
   b. Make a fist and place thumb side against client’s abdomen; place fist midline, just above the umbilicus, and below the xiphoid.
   c. Place other hand over fist and press into client’s abdomen using quick upward thrusts.
   d. Repeat upward thrusts until foreign body is dislodged or client becomes unconscious.
   e. When client becomes unconscious, evaluate for presence of foreign body in the airway, remove if identified and attempt to ventilate.

2. Unconscious: Evaluate airway. Open airway and attempt to ventilate; if unable to ventilate, then proceed with steps for removal of foreign body.
   a. Position client supine, kneel astride the client’s thighs; with the heel of the hand, apply forceful upward thrust to the abdomen well below the xiphoid and above the umbilicus.
   b. Administer five abdominal thrusts, return to the client’s head, open the airway, and assess for breathing; if absent, provide two effective breaths.

Goal: To clear obstructed airway—infant (conscious and unconscious).

1. Straddle the infant over the forearm with the head dependent.
2. Deliver up to five forceful back blows between the shoulder blades.
3. Supporting the head, turn the infant back over and administer up to five chest compressions (lower one-third of the sternum, approximately one finger breadth below the nipple line).
4. Attempt to remove foreign body only if it can be visualized.
5. If infant becomes unconscious, check the mouth before giving breaths to see if foreign body can be identified.

✔ PEDIATRIC PRIORITY: Do not do a blind sweep of the infant or child’s mouth; the foreign body should be visualized before you attempt to sweep the mouth.
### WATER-SEALED CHEST DRAINAGE

#### PURPOSES
1. To remove air and/or fluid from the pleural cavity.
2. To restore negative pressure in the pleural cavity and promote reexpansion of the lung.
3. Placement of chest tubes. (Figure 10-6).

#### PRINCIPLE OF WATER-SEALED CHEST DRAINAGE

The water seal (or dry seal on some equipment) serves as a one-way valve; it prevents air, under atmospheric pressure, from reentering the pleural cavity. On inspiration, air and fluid leave the pleural cavity via the chest tube; the water or dry seal keeps the air and fluid from reentering.

**NURSING PRIORITY:** There must be a seal (either water or dry seal) between the client and the atmospheric pressure.

#### EQUIPMENT

**Three-chamber disposable chest drainage system:** A molded plastic system that provides a collection chamber, a water-sealed chamber, and a suction-control chamber. When “wet” suction is applied, there should be a continuous, gentle bubbling in the water in the suction-control chamber (see Figure 10-7).

**Two-chamber disposable chest drainage system:** A molded plastic system that provides a water-sealed chamber where atmospheric pressure is prevented from going into client’s pleural cavity via a one-way valve. The second chamber serves as a collection chamber.
Appendix 10-4 WATER-SEALED CHEST DRAINAGE—cont’d.

Nursing Implications

**Assessment**
1. Evaluate for hypoxia.
2. Evaluate character of respirations.
3. Assess for symmetrical chest wall expansion.
4. Evaluate breath sounds bilaterally.
5. Palpate around insertion site for subcutaneous emphysema.

**Intervention**
1. Perform range of motion of the affected arm and shoulder.
2. Encourage coughing and deep breathing every 2 hours.
3. Encourage ambulation if appropriate.
4. Administer pain medications as indicated.
5. Place in low Fowler’s or semi-Fowler’s position.

**Observe Drainage System for Proper Functioning**
1. Drainage level in tubing from the client should fluctuate (tidal): rise on inspiration and fall on expiration. The opposite occurs with positive-pressure mechanical ventilation.
2. Continuous bubbling should not occur in the fluid where water seal is maintained; continuous bubbling indicates an air leak; continuous bubbling should occur only in the system that maintains a third chamber for suction control.
3. Initial bubbling may occur in the water-sealed chamber with coughing or with deep respiration as air is moved out of the pleural cavity.

**Maintain Water-Sealed System**
1. Keep all drainage equipment below level of client’s chest.
2. Evaluate for dependent loops in the tubing; this increases resistance to drainage. All extra tubing should be coiled in the bed and flow in a straight line to the system.
3. Tape all connections.
4. Note characteristics and amount of drainage. Mark level on the drainage system as needed and every 8 hours.
5. Vigorous “milking” or stripping chest tubes is controversial. Stripping should not be done routinely on clients because it increases pleural pressures.
6. Notify the RN when the collection chamber when it is approximately half full. The increased volume in the collection chamber increases the resistance to the flow of drainage.
7. Do not clamp chest tubes during transport.

**TEST ALERT: Maintain client tube patency (chest tubes); reinforce client teaching on treatments and procedures.**

**Chest Tube Removal**
1. Criteria for removal of the tube:
   a. Minimum or no drainage.
   b. Fluctuations stop in the water-seal chamber.
   d. Client has good breath sounds and is breathing comfortably.
2. Procedure.
   a. Provide pain relief about 30 minutes before procedure.
   b. Generally, the physician will want the client in a low Fowler’s or semi-Fowler’s position, unless contraindicated.
   c. The physician will ask the client to exhale and hold it or to exhale and bear down (a Valsalva maneuver). Either of these procedures will increase the intrathoracic pressure and prevent air from entering the pleural space.
   d. With the client holding his or her breath, the physician will quickly remove the tube and place an occlusive bandage over the area; the client can then breathe normally.
   e. Assess the client’s tolerance of the procedure; a chest x-ray film should be obtained to determine that the lungs remain fully expanded.
Appendix 10-5  ARTIFICIAL AIRWAYS

Endotracheal Intubation - Placement of an endotracheal (ET) tube through the mouth or nose into the trachea (Figure 10-8).

**Purpose**
To provide an immediate airway in an emergency situation; to maintain a patent airway; to facilitate removal of secretions and provide airway for controlled ventilation.

**Nursing Interventions**
1. Provide warm, humidified oxygen.
2. Establish method of communication because the client cannot speak; child is unable to cry.
3. Maintain safety measures.
   a. Prevent client from accidentally removing tube: soft hand restraints, mittens, etc.
   b. Secure ET tube to the face.
   c. Child with an ET tube requires constant attendance.
4. As soon as tube is inserted, assess symmetry of chest expansion and bilateral breath sounds. Assess for presence of bilateral breath sounds every 2 hours. If tube slips farther into the trachea, it may pass into the right main stem bronchus, obliterating the left main stem bronchus. Determine placement by checking breath sounds.
5. Cuff must remain inflated if client is on a volume ventilator. If the client has adequate spontaneous respiration and is not on a ventilator, the cuff may be left deflated.
6. Minimal occluding volume (MOV) should be used when inflating the cuff to prevent aspiration or to maintain mechanical ventilation. This is accomplished by placing a stethoscope over the trachea or by listening to the client’s breath sounds to determine when air stops moving past the cuff. A safe pressure on the cuff is 20 to 25 mm Hg.
7. Provide frequent oral hygiene; assess for pressure areas on the nose or the mouth.
8. Client’s nothing-by-mouth (NPO) status is maintained as long as tube is in place.
9. Suction as indicated (see Appendix 10-6).

Tracheostomy - A surgical opening in the trachea (Figure 10-8).

**Purpose**
To maintain airway over an extended period of time; to facilitate removal of secretions.

**Nursing Interventions**

*Initially After Tracheostomy*
1. Provide warm, humidified oxygen.
2. Small amount of bleeding around the tube is expected.
3. Observe for pulsations of the tube; it may be resting on the innominate artery; notify physician of observation.
4. Maintain frequent contact and communication with client and provide reassurance.

*Maintenance of Tracheostomy*
1. Provide warm, humidified oxygen.
2. Establish method of communication because client cannot speak; child is unable to cry.
3. Maintain safety measures.

FIGURE 10-8 Artificial airways. Position of endotracheal tube. (From Potter PA, Perry AG: Fundamentals of nursing, ed 7, Mosby.)
Appendix 10-5  ARTIFICIAL AIRWAYS—cont’d.

**TEST ALERT: Maintain tube patency – tracheostomy tube; provide care for a client with a tracheostomy.**

a. Secure tracheal tube to the client’s neck.
b. Use safety measures to prevent client from dislodging tube: soft restraints, trach ties, etc.
c. Prevent clothing or bed covers from occluding area of tracheal opening.
d. Child with a tracheostomy requires continuous attendance.
4. Assess for symmetrical expansion of chest wall and bilateral breath sounds.
5. Assess levels of pulse oximetry.
6. Provide frequent oral hygiene; turn every 2 hours.
7. Inflate tracheostomy cuff during tube feedings or feedings by mouth (minimal occluding pressure).
8. Cuff must remain inflated if client is on a ventilator. If the client has adequate spontaneous respiration, the cuff may be left deflated.
9. Suction as indicated (see Appendix 10-6).
10. If the tracheal tube has an obturator, it should be taped to the head of the bed. If the tracheostomy tube is accidentally removed, the obturator will be necessary for replacing the tube.
11. A fenestrated tracheostomy tube can be adapted so that air will flow throughout normal passages; frequently used when client is beginning to be weaned from the ventilator. If client has respiratory difficulty when the inner cannula is removed, immediately reinsert the cannula to provide a tracheal airway. The tube can also be plugged so that client can speak or cough through normal airway. Make sure the cuff is deflated before plugging the tracheostomy.
12. Establish means of communication; keep call light within easy reach of client.
13. If the client accidentally removes the tube, use the obturator to attempt to replace the tube in the tracheal opening. If unable to replace tracheotomy tube, hold the opening open with a hemostat until physician is available to replace the tube.

**NURSING PRIORITY:** The purpose of the cuff on a tracheostomy tube or on an ET tube is to facilitate the delivery of air to the lungs, not to secure the tube position.

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**NURSING PRIORITY:** Suctioning the endotracheal tube or the tracheostomy is done to remove excess secretions and to maintain patent airway. Suctioning should always be done before a cuff is deflated.

1. Determine that the client needs to be suctioned.
   a. Auscultate lungs to detect presence of secretions.
   b. Observe to see whether client is experiencing immediate difficulty with removal of secretions.
2. Explain procedure if client is not familiar with it, or simply indicate you are going to assist with the removal of the secretions.
3. All equipment introduced into the trachea or the ET tube must be sterile.
4. Prepare equipment by attaching the suction catheter to the suction source while maintaining sterile technique.
5. If client is not in immediate danger of airway occlusion, hyperoxygenate with 100% $O_2$ for three to four hyperinflations.
6. Gently insert sterile catheter into the opening without applying suction. Insert catheter to the point of slight resistance; then pull catheter back 1 to 2 cm.
7. Apply intermittent suction as the catheter is gently rotated and withdrawn.
8. Each suctioning pass should not exceed 10 to 15 seconds in duration.
9. Reconnect client to oxygen source and evaluate whether one suctioning episode was sufficient to remove secretions.
10. Hyperoxygenate client for 1 to 5 minutes after suctioning; assess vital signs and pulse oximetry—$SaPO_2$ levels should return to normal or to the previous levels before suctioning.
11. Avoid suctioning client before drawing blood for determination of arterial blood gas values. Client should be allowed to stabilize for approximately 30 minutes before blood is drawn.
12. Monitor pulse oximetry while suctioning; if oximetry does not come back to normal level immediately after suctioning, do not attempt to suction client again; replace oxygen and or ventilatory connection and call for assistance.

**COMPLICATIONS OF SUCTIONING**

1. **Hypoxia:** If possible, preoxygenate with high percentage of $O_2$ before and after suctioning.
2. **Dysrhythmias:** Limit suctioning to 10 to 15 seconds; monitor rhythm during suctioning; if bradycardia or tachycardia develops, discontinue suctioning immediately.
3. **Bronchospasm:** Try to time the suctioning with client’s own cycle; insert tube during inspiration.
4. **Airway trauma:** Maintain suction level below 120 mm Hg.
5. **Infection:** Use sterile technique; assess the color and quantity of sputum suctioned.
6. **Atelectasis:** Use suction catheters that are approximately one-third or less of the diameter of tube.

**TEST ALERT:** Intervene to improve client respiratory status by suctioning.
OXYGEN

Goal: The goal of oxygen therapy is to maintain an optimum level of oxygenation at the lowest effective level of fraction of inspired oxygen (Fio₂).

Methods of Administration
1. Low-flow systems: nasal cannula, standard mask, nonrebreather mask. Oxygen is measured in liters per minute flow (LPM): a range of 2 to 8 LPM is the most common order.
2. High-flow systems: Venturi mask, nebulizer mask, and ventilators. Oxygen is measured as Fio₂ in concentrations from 24% to 100%: 10 LPM oxygen flow is required to obtain accurate percentage flow.

Humidification
1. Adds water vapor to inspired gas.
2. Prevents drying and irritation of respiratory membranes.
3. Loosens thick secretions, allowing them to be more easily removed.

Indications for Oxygen Administration
1. A decrease in oxygen in the arterial blood (hypoxemia).
2. An increase in the work of breathing.
3. To decrease the cardiac workload.

TEST ALERT: Intervene to improve client’s respiratory status by giving a breathing or respiratory treatment.

Oxygen Safety in Administration
1. Properly ground all electrical equipment.
2. Do not permit any smoking by anyone in the area.
3. Use water-based, not oil-based, lubricants.
4. Use oxygen with caution in clients with chronic airway disease; most often administered via mask or nasal cannula at 2 to 4 LPM, unless client is in severe distress.
5. Oxygen supports combustion but is not explosive.

OXYGEN TOXICITY: A medically induced condition produced by inhalation of high concentrations of oxygen over a prolonged period of time. Toxicity is directly related to concentration of oxygen, duration of therapy, and degree of lung disease present.
1. Tracheal irritation and cough.
2. Dyspnea and increasing cough.
3. Decrease in vital capacity.
4. The Pao₂ continues to decrease, even with an increasing Fio₂.
5. Atelectasis.

TEST ALERT: Assure safe functioning of client care equipment, follow facility protocols for safe use of equipment.
**Nursing Implications**

1. Sputum for culture and sensitivity should be collected as soon as possible to facilitate identification of bacteria and treatment.
2. Specimens for cytology and for acid-fast bacilli for TB diagnostics should be collected in the morning when bacteria and cells are most concentrated.
3. No mouthwash should be used before collection of specimen; have client rinse his mouth with water or brush his teeth with water, but do not use toothpaste.
4. Aerosol mist will assist in decreasing thickness of sputum and increasing effectiveness of coughing.
5. Maintain strict asepsis and standard precautions in collecting and transporting specimen; use sterile specimen collection container.
6. Acid-fast bacillus: Sputum collection should be done on three consecutive days.
7. Culture and sensitivity: Initial specimen should be obtained before antibiotics are administered.

**Clinical Tips for Problem Solving**

*If client experiences pain while coughing:*
Support painful area with roll pillows to minimize pain and discomfort.
Encourage client to take several deep breaths before beginning. This assists in triggering the cough reflex and aerates the lungs (see Box 10-2).

*If client is unable to produce sputum specimen:*
Attempt procedure early in the morning, when mucus production is greatest.
Notify physician to obtain orders for a bronchodilator or nebulization therapy.
TEST ALERT: Monitor and maintain clients on a ventilator.

Mechanical ventilators regulate the rate and depth of respirations. Settings are frequently evaluated and adjusted based on ABG results to maintain optimum ventilation and gas exchange. An endotracheal tube or a tracheostomy are used to maintain airway.

PATTERNS OF VENTILATION

1. **Assist control (AC):** The client may initiate the cycle with inspiration.
2. **Continuous mandatory ventilation (CMV):** The machine controls rate and volume of the client’s ventilatory cycle.
3. **Intermittent mandatory ventilation (IMV)/synchronized intermittent mandatory ventilation (SIMV):** Delivers ventilation at inspiratory phase of client’s spontaneous ventilation; may be used for weaning from ventilator.
4. **Positive end-expiratory pressure (PEEP):** Maintains positive pressure at alveolar level at end of expiration to facilitate the diffusion of oxygen. PEEP will increase the intrathoracic pressure, thus further decreasing the venous return and causing a decrease in blood pressure.
   
   **Indications for use:** Acute respiratory distress syndrome (ARDS); clients unable to maintain patent airway; neuromuscular diseases causing respiratory failure.
5. **Continuous positive airway pressure (CPAP):** Used to augment the functional residual capacity (FRC) during spontaneous breathing. Used to wean clients from ventilators and may be administered by face mask. Client or infant must have spontaneous respirations.

TEST ALERT: Provide care to a client on a ventilator; implement measures to manage/prevent possible complication of client condition or procedure.

NURSING IMPLICATIONS

1. All alarms should be set and checked each shift, especially low pressure and low exhaled volume.
2. A bag-valve mask resuscitator is placed in the client’s room in case of mechanical failure of equipment.
3. Ventilator setting for fraction of inspired oxygen (FiO₂), tidal volume, respiratory rate, pattern of control (AC/IMV, etc.), and PEEP should be checked and charted.
4. Assess client’s tolerance of the ventilator; intravenous medications are frequently used. If changes, weaning, or removal of the ventilator are anticipated, do not sedate the client.
5. The client frequently experiences a high level of anxiety and fear. Explain equipment and alarms to the client and to the family. Maintain a calm, reassuring approach to the client.
6. When ventilator changes are made, carefully assess the client’s response (pulse oximetry, vital signs, ABGs).
7. Never allow the condensation in the tubing to flow back into fluid reservoir.

COMMON VENTILATOR ALARMS

1. **High pressure alarm:** Sounds when tidal volume cannot be delivered at set pressure limit.
   
   **Nursing Care:** Increased secretions—suction; client biting tube—place oral airway; coughing and increased anxiety—administer sedative.
2. **Low pressure alarm:** Sounds when the machine cannot deliver the tidal volume because of a leak or break in the system.
   
   **Nursing Care:** Disconnection—check all connections for break in system; tracheostomy or endotracheal (ET) tube cuff is leaking—check for air escaping around cuff; may need to replace tracheostomy tube if cuff is ruptured.

WEANING FROM VENTILATORS

May be done via SIMV, or T-piece on ET or tracheotomy with heated mist and oxygen, or by pressure support ventilation from the ventilator. During weaning it is imperative for the nurse to maintain close observation for increasing dyspnea and hypoxia. If client experiences dyspnea, he or she should be returned to the ventilator at whatever parameters were being used, and the doctor should be notified; anticipate drawing blood for determination of arterial blood gas values.

✔ **NURSING PRIORITY:** Focus on the client not on the ventilator. In case of problems with the ventilator, assess the client; if adequate ventilation is not being achieved, take client off the ventilator, maintain respirations via a bag-valve mask resuscitator, and call for assistance.