Before reading this information, stop and concentrate on breathing. Place a hand on the chest or abdomen and pay attention to inhaling and exhaling. Now, take a deep breath, hold it, and count to 10. Repeat that and count to 20. Now, try to imagine how life would change if every breath caused pain. For most of us, breathing is a natural and unconscious act, not even noticed, but many patients with respiratory disease are aware of every breath they take.

Many patients have problems related to the respiratory system. Other patients may have difficulty breathing even though their primary diagnosis is not related to the respiratory system.

A first step is always to assess a patient’s ability to breathe, regardless of diagnosis or complaints. A patient’s respiratory system may become compromised without them recognizing or verbalizing a problem with breathing. Monitor the patient’s respiratory rate and regularity. Note whether the rise of the patient’s chest wall is equal on both sides or if the patient is short of breath or is struggling to breathe. If the patient is unusually anxious, the ability to breathe may easily be impaired.

Paying attention to the patient’s respiratory system and ability to breathe unimpeded is a very important responsibility.
LEARNING OBJECTIVES

1. Describe nursing interventions that promote lung expansion and respiratory efficiency.
2. Implement safety standards related to respiratory care skills.
3. Identify indications for performing postural drainage, percussion or vibration therapy.
4. Discuss basic techniques of chest tube management.
5. Demonstrate the ability to utilize a pulse oximeter.
6. Demonstrate the ability to collect a throat culture.
7. Demonstrate the ability to collect a sputum specimen.
8. Demonstrate the ability to assist a patient with deep breathing/coughing exercises.
9. Demonstrate the ability to perform postural drainage, percussion, and vibration.
10. Demonstrate the ability to perform oronasopharyngeal suctioning.
11. Demonstrate the ability to instruct a patient to utilize incentive spirometry.
12. Demonstrate the ability to initiate oxygen therapy via piped-in wall unit.
13. Demonstrate the ability to initiate oxygen therapy via cylinder.
14. Demonstrate the ability to use an oxygen concentrator.
15. Demonstrate the ability to initiate oxygen therapy via oxygen delivery systems:
   • Nasal cannula and mask
   • Flow-by
   • Trach collars
   • Face shields and oxygen hoods
   • Face tent
16. Demonstrate the ability to perform endotracheal suctioning.
17. Demonstrate the ability to perform tracheostomy care.
18. Demonstrate the ability to provide care for a patient with a chest tube.
LEARNING OBJECTIVES

Objective Describe nursing interventions that promote lung expansion and respiratory efficiency.

Objective Implement safety standards related to respiratory care skills.

NURSING INTERVENTIONS AND SAFETY STANDARDS

Nursing interventions for promoting and maintaining adequate oxygenation include positioning, coughing techniques and preventive health behaviors as well as monitoring oxygen therapy, hydration, lung inflation techniques, spirometry, and medications.

The position of the patient affects the patient's ability to breathe with minimal exertion. A semi-Fowler's or Fowler's position promotes lung expansion and respiratory efficiency.

Breathing exercises can be used to optimize oxygen and carbon dioxide (gas) exchange, promote lung expansion, minimize atelectasis, decrease dyspnea, and promote secretion removal. This module will focus on two major types of breathing exercises:

1. Those used to promote lung expansion and minimize atelectasis. These techniques include deep breathing, deep breathing with breath stacking, deep breathing with inspiratory hold, and incentive spirometry.

2. Those used to reduce dyspnea and to promote lung expansion or minimize atelectasis in individuals with moderate to severe chronic respiratory disease. These include breathing control and pursed lip breathing techniques.

Taking a slow deep breath and then holding one's breath produces a uniform distribution of ventilation compared with rapid inspiration. Therefore, breathing control and pursed lip breathing techniques are thought to result in improved gas exchange.

The nurse must be aware of how actions and demeanor can affect the respiratory status of the patient.

Consider the following:

- How is breathing affected during a work-out or when rushing to complete tasks?
- Ever out of breath on exertion?
- How is breathing affected when nervous, frightened, or angry?

As a nurse and as a patient advocate, you must protect the patient. You must be aware of the patient's tolerance for activity and ensure that the patient does not become too tired, as fatigue may compromise respiratory status.

Normal oxygen saturation values are 97% to 99% in the healthy individual. An oxygen saturation value of 95% is clinically accepted in a patient with a normal hemoglobin level in order to minimize the risk of oxygen concentration and possible lung damage. By measuring the pulse oximetry, it is possible to utilize the lowest possible oxygen flow that will allow the patient to maintain acceptable oxygen saturation.

Replacement of oxygen to patients with impaired breathing can be accomplished by administering oxygen via mask, cannula, or endotracheal tube. (Oxygen is a safe gas and is non-flammable. Oxygen itself does not burn, but it contributes to the burning process. Materials burn more readily in an oxygen-enriched environment.)

Patients who receive oxygen concentration of more than 50% for 48-72 hours may suffer lung damage. Oxygen should be delivered at the lowest effective concentration for the shortest time possible. This is known as oxygen concentration and cannot always be reversed. The symptoms are subtle and the exact damage is not known. One theory is that oxygen toxicity reduces the elasticity in the lungs.
FUNDAMENTALS OF NURSING

FOR YOUR INFORMATION

The American Lung Association offers the following safety tips for oxygen use:

- Avoid open flames in the presence of oxygen use — e.g. matches, cigarette lighters, candles, and burning tobacco.
- Caution must also be used around other sources of heat, such as electric or gas heaters and/or stoves.
- People using oxygen should avoid using lotions or creams containing petroleum. The combustion of flammable products containing petroleum can also be supported by the presence of oxygen.
- It is important to store cylinders safely — upright and secure, in an approved cart or device.
- Remember when not in use, oxygen supply valves should be turned off.
- Always follow the instructions of your oxygen supply company regarding safe usage.

Following these simple safety tips will allow patients for whom oxygen is a necessity to maintain their health without incident.

LEARNING OBJECTIVES

Objective Identify indications for performing postural drainage, percussion or vibration therapy.

Objective Demonstrate the ability to assist a patient with deep breathing/coughing exercises.

Objective Demonstrate the ability to perform postural drainage, percussion, and vibration.

Objective Demonstrate the ability to instruct a patient to utilize incentive spirometry.

PROMOTING OXYGEN EXCHANGE

Chest Physical Therapy

People who benefit from chest physical therapy (CPT) exhibit a wide range of problems that make it difficult to clear secretions from their lungs after surgery, obstructive pulmonary diseases, and other respiratory conditions such as pneumonia or flu. CPT is the term for a group of treatments designed to improve respiratory efficiency, promote expansion of the lungs, strengthen respiratory muscles, and eliminate secretions from the respiratory system. The physician may order CPT to help patients breathe more freely and to get more oxygen into the body.

CPT will help prevent accumulation of bronchial secretions, promote mobilization of bronchial secretions, and improve efficiency of cough mechanism and distribution of ventilation.

Indications for chest physical therapy include:

- Excessive accumulation of secretions, as seen in many acute or chronic pulmonary diseases
- Retained secretions caused by dehydration and pulmonary disease
- Prophylactic care of preoperative patient with history of pulmonary problems or potential postoperative pulmonary problems

CPT includes:

- **Postural drainage**
- Chest percussion performed with cupped hands over the chest wall to loosen mucus plugs
- Coughing and deep breathing exercises
- Chest vibration
- Turning the patient
- Incentive spirometry

CPT is usually done in conjunction with other treatments to rid the airways of secretions. These other treatments include suctioning, nebulizer treatments, and the administration of expectorant drugs.

CPT can be used with newborns, infants, children, and adults. It is important not to perform the treatment immediately after mealtime due to the possibility of nausea, vomiting, and reflux.
Turning

Turning from side to side permits lung expansion. Patients who cannot turn themselves are turned by a caregiver. The head of the bed is also elevated to promote drainage if the patient can tolerate this position. Critically ill patients and those dependent on mechanical respiration are turned once every one to two hours around the clock.

Deep Breathing Exercises

Deep breathing helps expand the lungs and forces better distribution of the air into all areas. The patient may initially need to lie down to do these exercises, but eventually it is done while sitting upright, then while walking.

Patients, if tolerated, may find it helpful to monitor their breathing by placing a hand on their abdomen to provide a sense of their regular breathing pattern. The patient then starts by taking a deep breath through the nose, then pursing the lips as if to whistle. The patient then exhales the air slowly through pursed lips. The exhalation should take twice as long as the inhalation. A patient may start by inhaling for two seconds and then exhaling for four. After taking several deep breaths, the patient breathes at a normal rhythm and begins another cycle of deep breathing. The patient builds up to taking deeper breaths, following a schedule given by the health care team. Generally, patients with obstructive pulmonary diseases practice deep breathing exercises for 20 minutes each day.

Coughing

Coughing helps break up secretions in the lungs so that the mucus can be suctioned out or expectorated. However, for patients with obstructive pulmonary diseases, it can be painful to cough normally. An important part of CPT is teaching patients to clear their airways by gentler methods, such as with a controlled cough or by “huffing.”

In order to obtain a controlled cough, assist the patient to sit upright. The patient should then purse the lips and take a deep breath. Ask the patient to hold his/her breath for several seconds and then make two brief, gentle coughs. Huffing also starts with pursing the lips and taking a deep breath. After holding the breath for several seconds, the patient should exhale by using the stomach muscles to push the air out. The vocal chords remain open so that the cough has almost a whispy sound. Coughing and huffing are repeated several times a day as needed.

Deep Breathing and Coughing Exercises

1. Prepare the patient for deep breathing and coughing.
   - Identify patient and explain procedure.
   - Give pain medication, if needed, about 30 minutes prior to procedure.
   - Gather a small pillow or folded blanket, tissues, and gloves.
   - Assist patient to Fowler’s or supine position with knees flexed.
   - Wash hands and follow standard precautions.

2. Instruct the patient to breathe deeply and cough.
   - Assist patient to splint the surgical site or painful area, if applicable, with a pillow or folded blanket.
   - Instruct patient to inhale slowly through the nose and exhale slowly through the mouth with lips pursed for three or four breaths.
   - Instruct patient to cough during expiration with mouth open.
   - Provide tissues and note the amount, color, and consistency of any sputum.

3. Complete the procedure.
   - Leave patient safe and comfortable.
   - Document in the nurses’ notes the instructions given to the patient and the patient’s ability to follow those instructions.
   - Document amount, color, consistency, and odor of any sputum produced.
   - Document how the patient tolerated the procedure, including complaints of pain.

Postural Drainage

Drainage involves a patient assuming various positions to facilitate the flow of secretions from various parts of the lung into the bronchi, trachea, and throat so that they can be cleared and expelled from the lungs more easily.
Prior to placing the patient in the postural drainage position, determine if they have *gastric esophageal reflux disease* (GERD) or *intracranial pressure* (ICP) and a physician’s order. Optimal positioning may be difficult in patients with conditions that prevent the needed positioning or in critically ill patients. Airway clearance may be less than optimal in patients with ineffective cough.

The diagram below shows the correct positions to assume for draining different parts of the lung.

**PERCUSSION**

*Percussion* is also referred to as cupping or clapping. Never percuss over bare skin. Place a light cloth or pillowcase over the area and cup hands over the ribcage in the various positions, but not over stomach or spine. Percuss with cupped hands for three to five minutes at each location, starting with the lower lobes and working upward. Keep fingers slightly curled and thumb against first finger and arm and wrist loose and relaxed. Percussion should produce a hollow sound, not a slap. Infants should be percussed at a rate of 60-80 times per minute. Older children and adults may be percussed at a faster rate. Patients should be encouraged to cough at the end of each three- to five-minute session. *Auscultation* the patient’s lungs will evaluate the effectiveness of the therapy.

This procedure is often done by registered respiratory therapists, but occasionally LPNs may be required to perform this skill.

### Positions for Lung Drainage

**Apical Segment**

- Right Upper Lobe
- Left Upper Lobe

**Inferior Segment**

- Right Lower Lobe
- Left Lower Lobe

Elevate foot 30 cm (12 in.)

Elevate foot 50 cm (20 in.)

Elevate foot 30 cm (12 in.)

Elevate foot 50 cm (20 in.)
VIBRATION

Vibration involves the application of a fine pulsating action. Place the hand firmly over the area to be drained. Do not move the skin back and forth over the chest wall. Vibrate three to five times while the patient exhales, preferably through pursed lips. Vibrate during five exhalation cycles over each chest segment. Encourage the patient to cough at each location. Auscultating the patient’s lungs will evaluate the effectiveness of the therapy.

Percussion and vibration are often done by registered respiratory therapists, but occasionally LPNs may be required to perform this skill.

Q: What would you say to a patient who is resisting a CPT treatment?

SPIROMETRY

Incentive spirometry may be ordered to help patients practice and improve controlled breathing and after surgery. The incentive spirometer helps the patient improve lung function. This self-administered therapy involves inhaling into a tube attached to a device. The specific technique and goal depends on the type of spirometer being used.

Patients should be told they will be performing a breathing exercise.

- Do not call it a breathing treatment, as this promotes fear.
- Explain the exercise without any medical terms if possible.
- Never tell the patient that if they don’t do it they have a risk of getting a disease and dying.

During the exercise, the patient should be shown exactly how to do the correct method.

Some devices have a component designed for exhalation. If the model does not include an exhaling function, the patient breathes out air naturally.

At the end of the session, the patient takes a deep breath and then coughs. The length of therapy and the number of exercises done depend on the patient’s condition and is determined by a respiratory therapist or other health professional.

Types of Spirometer Devices

<table>
<thead>
<tr>
<th>Type of Device</th>
<th>Patient Action</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breath flow-oriented device</td>
<td>• Inhales through a tube to raise a ball inside the plastic spirometer chamber&lt;br&gt;• Drop in pressure causes the ball to rise</td>
<td>Keep the ball in the air for as long as possible</td>
</tr>
<tr>
<td>Volume-oriented device</td>
<td>• Sets a pointer on the chamber at the desired breath volume level&lt;br&gt;• The patient inhales into the tube</td>
<td>Attempts to raise a piston inside the chamber so that the volume marker reaches that level</td>
</tr>
<tr>
<td>Hybrid volume accumulators</td>
<td>• Concentration device&lt;br&gt;• Volume-oriented device&lt;br&gt;The patient inhales into the tube</td>
<td>Piston inside a cylinder responds to negative pressure from the patient’s inhalation</td>
</tr>
</tbody>
</table>
Perform Percussion and Postural Drainage

1. Prepare for the procedure.
   - Identify patient and explain procedure.
   - Gather two pillows, tissues, emesis basin, and gloves.
   - Wash hands and follow standard precautions.
   - Provide privacy for patient.
   - Auscultate breath sounds in all lobes, noting areas of congestion.

2. Perform percussion and postural drainage.
   For anterior right and left upper lobes:
   - Assist patient to high Fowler’s position or in a chair so gravity will assist in draining secretions from the upper lobes into the bronchi.
   - Stand behind patient and place the heels of your hands at patient’s shoulders with fingers over the clavicle. Keep hands cupped and moving in a rhythm similar to a horse galloping.
   - Percuss area for 15 to 20 repetitions, and then allow time for patient to cough. Assist with tissue if needed.
   For right and left posterior apical bronchi:
   - Assist patient to lean forward in chair or bed against two folded pillows.
   - Percuss left and right sides of upper torso with each hand. Be careful to keep hands over lung fields and not over the spine itself.
   - Percuss area for 15 to 20 repetitions, and then allow time for patient to cough. Assist with tissue if needed.
   For right middle lobe:
   - Assist patient to lie on left side with foot of bed raised 12 inches.
   - Place pillow behind patient’s back and roll patient so back is resting on the pillow.
   - Percuss right anterior, lateral, and posterior area, working from below the right nipple towards the head. Do not percuss over breast tissue as this may cause injury.
   - Percuss 15 to 20 times, and then allow time for patient to cough and rest. Assist with tissue if needed.
   For left middle area:
   - Turn patient to lie on right side with foot of bed elevated 12 inches.
   - Place pillow behind patient’s back and roll patient so back is resting on the pillow.
   - Percuss left anterior, lateral, and posterior area, working from below the left nipple towards the head. Do not percuss over breast tissue as this may cause injury.
   - Percuss 15 to 20 times, and then allow time for patient to cough. Assist with tissue if needed.
   For right lower lobe:
   - Assist patient to lie on left side with the foot of bed elevated 20 inches.
   - Percuss right anterior, lateral, and posterior area working from below the scapula to the nipple line. Do not percuss over kidney area as this may cause injury.
   - Percuss 15 to 20 times, and then allow time for patient to cough. Assist with tissue if needed.
   For left lower lobe:
   - Assist patient to lie on right side with the foot of bed elevated 20 inches.
   - Percuss left anterior, lateral, and posterior area working from below the scapula to the nipple line. Do not percuss over kidney area as this may cause injury.
   - Percuss 15 to 20 times, and then allow time for patient to cough. Assist with tissue if needed.

3. Complete the procedure.
   - Assist patient to a comfortable and safe position.
   - Assess breath sounds for improvement in congestion.
   - Document breath sounds before and after percussion and postural drainage.
   - Document amount, color, consistency, and odor of expectorated sputum.
   - Document patient’s response to procedure.
**Assist with Incentive Spirometry**

1. **Prepare for incentive spirometry.**
   - Identify patient and explain procedure.
   - Gather prescribed incentive spirometer, tissues, mouthwash, and gloves.
   - Wash hands and follow standard precautions.
   - Assist patient to semi-Fowler’s position.
   - Assess respiratory rate, depth, and breath sounds.

2. **Assist patient to use spirometer.**
   - Instruct patient to completely cover mouthpiece of spirometer with lips.
   - Instruct patient to inhale slowly through the mouthpiece, hold breath for two to three seconds, and then slowly exhale.
   - Allow time for patient to relax and breathe normally between using the spirometer.
   - Instruct patient to measure progress and to gradually increase depth of inspiration.

3. **Complete the procedure.**
   - Offer mouthwash after completing spirometry.
   - Note amount, color, consistency, and odor of any sputum produced. Deep breathing often brings on coughing.
   - Assess respiratory rate, depth, and breath sounds.
   - Clean mouthpiece and replace spirometer.
   - Leave patient safe and comfortable.
   - Document patient’s respiratory status before and after spirometry.
   - Document volume of inspired air and patient’s response to procedure.

**Learning Objectives**

**Objective** Demonstrate the ability to utilize a pulse oximeter.

**Objective** Demonstrate the ability to initiate oxygen therapy via piped-in wall unit.

**Objective** Demonstrate the ability to initiate oxygen therapy via cylinder.

**Objective** Demonstrate the ability to use an oxygen concentrator.

**Objective** Demonstrate the ability to initiate oxygen therapy via oxygen delivery systems:
- Nasal cannula and mask
- Flow-by
- Trach collars
- Face shields and oxygen hoods
- Face tent

**Oxygen Therapy**

**Pulse Oximetry**

Pulse oximetry uses a simple non-invasive method of monitoring that measures both the pulse and the saturation of hemoglobin in the blood stream. The pulse oximeter consists of a probe linked to a computerized unit that is attached to the patient’s finger or ear lobe. The unit displays the percentage of Hgb saturated with oxygen \((\text{oxyhemoglobin})\) together with an audible signal for each pulse beat, a calculated heart rate, and in some models, a graphical display of the blood flow past the probe. Audible alarms that can be programmed by the user are provided. An oximeter detects hypoxia before the patient becomes clinically cyanotic.

Basically, a saturation of 97% of the total amount of hemoglobin in the body is filled with oxygen molecules. Therefore, a pulse oximeter of 96% to 100% is generally considered normal. Anything below 90% could quickly lead to life-threatening complications. A pulse oximeter is critically important in emergency
medicine and is also very useful for patients with respiratory or cardiac problems. If the alarm sounds, check the patient's condition. If the patient is sleeping or lethargic, respirations may be shallow. Arouse the patient and encourage deep breaths.

Check the patient's nail beds for a sign of poor circulation, which include dark color in the extremities and finger pads that when *blanched*, do not return to a nice pink or pale color.

Q: Your patient had an emergency cholecystectomy yesterday. His oxygen saturation has been monitored since he arrived from recovery room and has been recorded at 97%. An aide tells you that the patient's alarm is sounding. When you enter the patient's room, the pulse oximeter alarm is beeping and the oxygen saturation is 85%. The patient is asleep and snoring softly. He looks peaceful and does not appear to be in distress. What do you do?

**Utilizing a Pulse Oximeter**

1. **Prepare to apply a pulse oximeter.**  
   - Identify patient and explain procedure.  
   - Gather pulse oximeter and disposable sensor or non-disposable clip.  
   - Plug oximeter into a working electrical outlet.  
   - Check oximeter and sensor to be certain they are in working condition.  
   - Wash hands and follow standard precautions.

2. **Apply and operate the oximeter.**  
   - Apply disposable sensor or non-disposable clip to the patient's finger. Other sites such as the toe, earlobe, or bridge of the nose can be used.  
   - Set alarm limits according to physician's order or agency policy.  
   - Observe oximeter for stabilized readings. Oxygen saturation values and pulse readings will change continuously on the oximeter readout. Look for the same values or very similar values to be repeated frequently to find stabilized readings.

3. **Document the procedure.**  
   - Document time the oximeter was applied, as well as the site of the sensor.  
   - Document stabilized O₂ and pulse reading.  
   - Document condition of the patient.  
   - Notify charge nurse or physician of O₂ readings below 90% or according to agency policy.

4. **Troubleshoot the oximeter.**  
   - Check O₂ and pulse values if alarms go off. If patient is sleeping or recovering from anesthetic, respirations may be shallow. Arouse patient and tell him or her to take deep breaths. Do not turn off alarms.  
   - Check fingernails for polish or fingertips for poor circulation or coldness if O₂ values read abnormally low.  
   - Check apical pulse rate if high or low pulse rate alarms sound.
OXYGEN SOURCES

Oxygen is provided from a variety of sources, including:

- **Piped-in wall unit**: This oxygen is provided from a central reservoir and is piped into the patient’s room via a wall unit.

- **Cylinder**: Steel cylinders of various sizes are known as “portable tanks” and store oxygen under high pressure. Tanks are identified via letters with smaller cylinders designated with a lower letter from the alphabet (i.e., an “e” cylinder holds less oxygen than an “h” cylinder). Cylinders are transported and stored while strapped to a carrier with casters. If a cylinder were to fall, it might spin forcefully and cause injury. Prior to administering oxygen from a portable tank, the nurse must turn the tank valve slightly to allow a brief release of pressurized oxygen. This turning of the valve is called “cracking” and must not be neglected. A slight hissing noise is noted when the tank is cracked. Patients should be made aware of the noise prior to cracking the tank so that anxiety can be avoided.

- **Concentrator**: These are electrically powered devices that remove nitrogen from air. They are most commonly used outside of the clinical areas because they do not need refilling. However, a number of manufacturers have introduced portable oxygen concentrators. These have eliminated the need to use liquid or gas cylinders and have increased mobility for many patients. These can typically use AC, DC, or battery power.
Operate Oxygen Valves on Wall Units and Cylinders

1. Prepare to operate oxygen valves.
   - Check physician’s order for oxygen administration method and flow rate.
   - Identify patient and explain procedure.
   - Gather flowmeter, humidifier bottle, distilled water, connecting tubing, administration device (cannula, mask, etc.), and “Oxygen in Use” sign if these are not already in place. For cylinders, also gather the cylinder, carrier, wrench, and regulator with flowmeter attached.

2. Operate an oxygen valve on a wall unit.
   - Fill humidifier bottle with distilled water and attach it to flowmeter.
     \[\text{NOTE: If oxygen is ordered at a flow rate of 3L/min or higher, a humidifier is usually used. This may vary according to facility policy.}\]
   - Ensure that flowmeter is turned off.
   - Insert flowmeter into oxygen outlet. In some facilities, you may need to insert the connection plug at an angle, and then turn it straight. In other facilities, you may need to pull down on the green oxygen button to open the connection plug, and then insert the flowmeter.
   - Attach connective tubing to the flowmeter.
   - Turn on flowmeter to ordered liters per minute, and feel for air coming out of the cannula or mask.
   - Check humidifier bottle for bubbles to indicate that oxygen is flowing.
   - Place mask or cannula on patient.

3. Operate an oxygen valve on a cylinder.
   - Transport cylinder to bedside using carrier, and leave both at bedside.
   - Remove protective cap from the top of the cylinder, then turn cylinder valve clockwise slowly until a loud hissing noise is heard.
   - Close valve quickly. This procedure is referred to as “cracking” an oxygen tank. Opening the valve for a brief moment blows off dust particles before the regulator is attached.
   - Connect regulator to the cylinder and tighten the nut with a wrench.
   - Fill humidifier bottle with distilled water and attach it to the regulator. If oxygen is ordered at a flow rate of 3L/min or higher, a humidifier must be used.
   - Ensure that flowmeter is turned off and connect tubing to the oxygen outlet.
   - Open cylinder valve slowly until it is fully open, then turn back one-quarter turn.
   - Turn on flowmeter to ordered liters per minute, and feel for air coming out of the cannula or mask.
   - Check humidifier bottle for bubbles to indicate that oxygen is flowing.
   - Place mask or cannula on patient.

4. Operate an oxygen concentrator.
   - Plug in concentrator.
   - Turn knob to ordered amount of oxygen.
   - Connect oxygen tubing to concentrator and connect administration device to other end of tubing.
   - Turn power on and ensure oxygen is flowing.
   - Place mask, cannula, or nasal catheter on patient.

5. Complete the procedure.
   - Leave patient safe and comfortable.
   - Post “Oxygen in Use” signs.
   - Document time oxygen was initiated, flow rate, type of administration used (mask or cannula), and patient condition.
**OXYGEN DELIVERY SYSTEMS**

- **Nasal cannula:** The nasal cannula (NC) is a thin tube with two small nozzles that protrude into the patient’s nostrils. It can only provide oxygen at low flow rates, two to six liters per minute (L/min), delivering a concentration of 28-44%. It is held in place by wrapping the tubing around the ears and adjusting the fit of the tubing at the chin.

- **Mask:** The simple face mask (SFM) is a basic mask used for non-life-threatening conditions. These conditions may progress in time, such as chest pain, which could indicate a possible heart attack, dizziness, and minor hemorrhages and require high-flow oxygen delivery. It is often set to deliver oxygen between two and ten L/min. The final oxygen concentration delivered by this device is dependent upon the amount of room air that mixes with the oxygen the patient breathes.

- **Non-rebreather mask (NRB):** The non-rebreather mask (NRB) is utilized for patients who require high-flow oxygen, but do not require breathing assistance. It has an attached reservoir bag where oxygen fills in between breaths, and a valve that largely prevents the inhalation of room or exhaled air.

- **Bag-valve-mask (BVM):** The bag-valve-mask (BVM) is used for patients in critical condition who are either breathing extremely inefficiently, or not breathing at all (for example, when a patient goes into respiratory arrest). An oxygen reservoir bag is attached to a central cylindrical bag, attached to a valved mask that administers almost 100% concentration oxygen at eight to 15 L/min. The central bag is squeezed manually to deliver a breath to the patient or to assist the patient in breathing by doing some of the work for the lungs.

- **Pocket mask:** The pocket mask, often used during CPR, is a small device that can be carried on one’s person. It is used for the same patients for whom the BVM is indicated, but instead of delivering breaths by squeezing a reservoir, the care provider must exhale into the mask. Exhaled air from the provider can provide up to 16% oxygen to the patient.
- **Flow-by**: Tubing used for patients who need the highest level of oxygen.

- **Trach collar**: A *tracheostomy collar* delivers oxygen via an artificial opening in the neck. The collar is applied over a *tracheostomy*. This collar provides oxygenation and humidification because it bypasses the warming and moisturizing functions of the nose.

- **Face shield**: The face shield is a large, soft plastic mask that covers the nose and mouth. It sometimes better tolerated than a smaller face mask. It is a low delivery oxygen device as it delivers only 40% oxygen at 10 to 15 L/min.

- **Oxygen hood**: The oxygen hood is a clear plastic shell that covers the patient’s head. It is well tolerated by infants, and the size of the hood limits its use to those patients who are less than one year old. It allows easy access to chest, trunk, and extremities. This is a high delivery oxygen device that delivers 80% to 90% oxygen at 10 to 15 L/min.

- **Face tent**: Designed for patients who cannot wear a mask or nasal prongs (e.g., facial surgery or trauma). It may be bulky and cumbersome.
### Apply a Nasal Cannula and Mask

1. **Prepare for the procedure.**
   - Check physician’s order for administration method and prescribed liter flow of oxygen.
   - Gather either an oxygen cannula or mask as ordered. Gather any other equipment for administering oxygen not already connected.
   - Identify patient and explain procedure.
   - Wash hands and follow standard precautions.
   - Attach connecting tubing to oxygen outlet.
   - Turn on oxygen to prescribed flow rate and check to feel air flow.

2. **Apply a nasal cannula.**
   - Place nasal prongs into patient’s naris, with curve toward patient.
   - Position tubing over the patient’s ears with the sliding adjustor under the chin.
   - Slide adjustor upward to secure the tubing. Use caution not to tighten the tubing so much that it causes discomfort on the ears or across the cheeks.
   - Cushion patient’s ears and cheeks with foam protector or gauze pad if needed.

3. **Apply an oxygen mask.**
   - Place mask over patient’s face, covering nose and mouth. If possible, allow patient to do this with your assistance, to lessen any sensation of smothering.
   - Place elastic strap around patient’s head and over patient’s ears.
   - Adjust to fit by tightening elastic strap.
   - Cushion patient’s ears with cotton balls or gauze pad if needed.

4. **Document the procedure.**
   - Document placement of cannula or mask, liter flow, and patient’s condition.

### Learning Objectives

- **Objective** Demonstrate the ability to collect a throat culture.
- **Objective** Demonstrate the ability to collect a sputum specimen.
- **Objective** Demonstrate the ability to perform oronasopharyngeal suctioning.
- **Objective** Demonstrate the ability to perform endotracheal suctioning.
- **Objective** Demonstrate the ability to perform tracheostomy care.

### Specimen Collection

#### Throat Culture

Throat cultures are done to determine if the patient has an infection of the oropharyngeal area.

Although having a throat culture taken is not pleasant for the patient, it can be done quickly and efficiently with no after-effects. No patient preparation, other than an explanation of the collection procedure, is necessary.
Obtain a Throat Culture

1. **Prepare to obtain the culture.**
   - Identify patient and explain procedure.
   - Gather culture tube or sterile swab, tongue blade, gloves, and flashlight if needed.
   - Assist patient to Fowler’s or a sitting position.
   - Wash hands and follow standard precautions.

2. **Swab the throat.**
   - Instruct patient to open mouth and say “ah,” as this allows the best view of the throat.
   - Place tongue blade on the tongue, but not back far enough to cause gagging.
   - Insert sterile cotton swab and quickly roll it over the most inflamed area of the throat. **Do not** allow the swab to touch the lips, teeth, tongue, or cheek.
   - Insert swab into the tube, crush the ampule in the end of the culture tube, and replace top of container.

3. **Complete the procedure.**
   - Attach label to culture tube container and send to laboratory with requisition.
   - Leave patient safe and comfortable.
   - Document that specimen was obtained and sent to the lab.
   - Document appearance of the throat and patient’s response to the procedure.

**Sputum Culture**

A sputum culture is a test to detect and identify bacteria or fungi (plural of fungus) that are infecting the lungs or breathing passages. Sputum is a thick fluid produced in the lungs and in the airways leading to the lungs. A sample of sputum is placed in a container with substances that promote the growth of bacteria or fungi. If no bacteria or fungi grow, the culture is negative. If organisms that can cause infection grow, the culture is positive.

The best time to collect a sputum sample is early in the morning, before the patient has anything to eat or drink. After rinsing the mouth with water to decrease mouth bacteria and dilute saliva, the patient must cough up sputum from within the chest. Taking deep breaths and lowering the head helps bring up the sputum. Sputum must not be held in the mouth but immediately spat into a sterile container.

If coughing up sputum is difficult, the nurse can have the patient breathe in sterile saline produced by a nebulizer. This nebulized saline coats the respiratory tract, loosening the sputum and making it easier to cough up.

If a patient is having difficulty expectorating their secretions, suctioning may be necessary to clear the air passages. Suctioning consists of removing secretions through a catheter or cannula that is connected to a suction device.

Suction catheters may be open tipped or whistle tipped. The open tipped allows for a more efficient suction, especially if the mucous is thick. However, the whistle tipped catheter provides less trauma to tissues in the respiratory system.

NOTE: The specimen for culture should be collected before antibiotics are started, since antibiotics may prevent germs in the sputum from growing in culture.
Obtain a Sputum Specimen

1. **Prepare to obtain the specimen.**
   - Identify patient and explain procedure.
   - Gather a sterile specimen container or sputum trap, tissues, and gloves.
   - Wash hands and follow standard precautions.

2. **Obtain the sputum specimen.**
   - Instruct patient that the specimen must be mucus coughed up from the lungs, not saliva.
   - Assist patient to a sitting or Fowler’s position.
   - Instruct patient to take several deep breaths and then to cough.
   - Instruct patient to expectorate mucus directly into the sterile container.
   - Continue until one to two teaspoons of mucus is collected.
   - Place lid on container and label.
   - Assist patient with tissues and oral care if desired.

3. **Complete the procedure.**
   - Clean outside of specimen container if needed.
   - Attach label to specimen container and send to laboratory with requisition.
   - Document that specimen was obtained and sent to the lab.
   - Document the characteristics of sputum obtained and patient’s response to the procedure.

**NOTE:** If the patient is unable to cough and produce a specimen, pharyngeal suctioning may be used to obtain a sputum specimen. This may be done by the respiratory therapist. Follow facility policy.

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**Oropharyngeal Suctioning**

**Oropharyngeal suctioning** is used when the patient is able to cough effectively but is unable to clear secretions by expectorating or swallowing. Oropharyngeal suctioning is the act of removing secretions from the throat through an orally inserted catheter instead of through the nostrils (nasopharyngeal suctioning).

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**Nasopharyngeal suctioning**

**Nasopharyngeal suctioning** is removing secretions from the throat and upper portion of the airway via a flexible tube inserted through the nose. This is used when the patient is able to cough effectively but is unable to clear secretions in the lower portion of the airway and throat by expectorating or swallowing.

Suctioning relies on negative pressure to remove liquid secretions with a catheter. In order to suction a patient safely, the patient should receive a thorough explanation of the procedure. This will calm the patient’s fears and help insure that the patient is cooperative throughout the procedure and does not interfere with the procedure because of fear or a feeling of panic. Explain to the patient that you will control the catheter to prevent any injury. The patient should understand that the suction will not begin until the catheter is properly placed. Let the patient know that the actual suctioning process will last only five to 10 seconds. After that time, you will remove your thumb from the control and stop the suction. You will immediately remove the catheter and the patient will have a rest period. Explain to the patient that he/she will have less than normal oxygen supply while the suctioning is in place and emphasize that this will last only a few seconds.

During oropharyngeal suctioning, it is not necessary to use sterile equipment, but sterile equipment is often used to prevent infection. The hand used to guide the suction catheter should remain sterile to help prevent infection. The other hand remains gloved to protect the nurse from the patient’s body fluids.
Suctioning

1. Prepare for suctioning.
   - Identify patient and explain procedure.
   - Gather sterile saline, sterile cup, and tonsillar tip (Yankauer) for oral suctioning or suction kit for nasopharyngeal suctioning, tissues, and towel.
   - Place towel over patient’s chest.
   - Wash hands and follow standard precautions.
   - Ensure that suction apparatus works and that connectors are in place.
   
   NOTE: Wall suction settings should be used as follows, or as indicated in physician’s orders:
   - Infants 50-95 mm Hg
   - Children 95-110 mm Hg
   - Adults 110-150 mm Hg

2. Prepare for suctioning.
   - Open sterile catheter and glove kit while maintaining sterile technique.
   - Connect thumb-control end of catheter to suction tubing. Leave the suction end of the catheter inside the sterile package.
   - Pour sterile saline into sterile cup.

3. Perform oropharyngeal suctioning.
   - Put on sterile gloves.
   - Turn on suction.
   - Hold suction end of tonsillar tip catheter in dominant hand and thumb-control end in non-dominant hand.
   - Dip end of tonsillar tip catheter into sterile saline to lubricate.
   - Insert tonsillar tip catheter gently into one side of the mouth. Glide towards oropharanynx without suction.
   - Place thumb over opening to apply suction and move tonsillar tip catheter around mouth until secretions are removed. Encourage patient to cough to move secretions into the mouth for suctioning.
   - Allow rest period for the patient. Encourage a few breaths.
   - Rinse the suction catheter as needed by placing it in the cup of sterile saline and applying suction.
   - Repeat procedure as needed.

4. Perform nasopharyngeal suctioning.
   - Put on sterile gloves.
   - Turn on suction.
   - Hold suction end of suction catheter in dominant hand and thumb-control end in non-dominant hand.
   - Lubricate suction catheter with water-soluble jelly or sterile saline.
   - Insert suction catheter gently into one side of the nose. Glide towards oropharanynx without suction.
   - Place thumb over opening to apply suction and rotate suction catheter slightly while withdrawing it.
   - Hold your breath and when you are uncomfortable, so is your patient. Limit suction time to 10-15 seconds. Remove thumb from thumb-control every two to three seconds.
   - Rinse suction catheter as needed by placing it in the cup of sterile saline and applying suction.
   - Allow patient to rest and repeat suctioning as needed. Administer any ordered oxygen between suctioning procedures.

5. Complete the procedure.
   - Turn off suction.
   - Disconnect suction catheter and remove glove over catheter; discard both.
   - Leave patient comfortable and safe.
   - Document procedure, amount and color of mucus obtained, and patient response to procedure.
Endotracheal Suctioning

1. **Prepare for suctioning.**
   - Identify patient and explain procedure.
   - Gather a suction kit, or sterile saline, sterile cup, tissues, and towel.
   - Place towel over patient's chest.
   - Wash hands and follow standard precautions.
   - Ensure that suction apparatus works and that connectors are in place.

2. **Prepare for suctioning.**
   - Open sterile catheter and glove kit while maintaining sterile technique.
   - Connect thumb-control end of catheter to suction tubing. Leave the suction end of the catheter inside the sterile package.
   - Pour sterile saline into sterile cup.

3. **Perform sterile procedures for suctioning.**
   - Put sterile glove on dominant hand.
   - Turn on suction with non-dominant hand.
   - Hold suction end of catheter in dominant hand and thumb-control end in non-dominant hand.
   - Dip end of catheter into sterile saline to lubricate.
   - Insert suction catheter gently into tracheostomy to a depth of three inches or until resistance is felt. Do not use suction during insertion.
   - With dominant hand, place thumb over trach opening to apply suction.
   - Rotate and remove the catheter. Suction for 10 to 15 seconds at a time, removing your thumb from the thumb-control every two to three seconds.
   - Rinse the suction catheter as needed by placing it in the cup of sterile saline and applying suction.
   - Allow time for patient to cough and rest when needed.

4. **Complete the procedure.**
   - Turn off suction.
   - Disconnect suction catheter and remove glove over catheter; discard both.
   - Leave patient comfortable and safe.
   - Document procedure, amount and color of mucus obtained, and patient response to procedure.

**TRACHEOSTOMY CARE**

Often, the terms tracheotomy and tracheostomy are used interchangeably. A trachecotomy is a surgical procedure that is usually done in the operating room under general anesthesia. An incision into the trachea (windpipe) forms a temporary or permanent opening that is called a tracheostomy. The opening, or hole, is called a stoma.

A tracheostomy allows air to enter the lungs when the airway is blocked due to a tumor, swelling, or foreign body. Some patients will have tracheostomies that are permanent. Others may have temporary tracheostomies. Proper stoma care is required to maintain healthy tissue.

Secretions from the tracheostomy can cause the area around the stoma to become moist, irritated, or infected. The nurse must observe the area around the stoma for redness, swelling, drainage, or bleeding and report observations to the supervisor or physician.
Basic Tracheostomy Care

1. Prepare for tracheostomy care.
   • Identify patient and explain procedure.
   • Gather a tracheostomy care kit, clean gloves, and sterile gloves (if not included in kit).
   • Ensure that a sterile hemostat, obturator, curved guide, and tracheostomy set are at the bedside.
   • Wash hands and follow standard precautions.
   • Assist patient to semi-Fowler’s position.

2. Perform non-sterile procedures in tracheostomy care.
   • Open the tracheostomy care kit and set up sterile field.
   • Empty contents of kit onto a sterile field.
   • Pour hydrogen peroxide into one basin of the tracheostomy cleaning kit and sterile saline into the other side.
   NOTE: Endotracheal suctioning is performed at this time.

3. Put sterile glove on dominant hand.
   • Turn on suction with non-dominant hand.
   • Hold suction end of catheter in dominant hand and thumb-control end in non-dominant hand.
   • Dip end of catheter into sterile saline to lubricate.
   •Insert suction catheter gently into tracheostomy to a depth of three inches or until resistance is felt. Do not use suction during insertion.
   • With dominant hand, place thumb over opening to apply suction.
   • Rotate and remove the catheter. Suction for 10 to 15 seconds at a time, removing your thumb from the thumb-control every two to three seconds.
   • Rinse the suction catheter as needed by placing it in the cup of sterile saline and applying suction.
   • Allow time for patient to cough and rest when needed.

4. Perform sterile procedures in tracheostomy care.
   • Wearing clean gloves, unlock the inner cannula, remove it, and place it in the basin filled with hydrogen peroxide, if the cannula is not disposable.
   • Clean inner cannula using small bristle brush found in trach care kit.
   • Rinse inner cannula in basin containing sterile saline. Inspect for mucus.
   • Dry inside of inner cannula using doubled pipe cleaners; dry outside with gauze squares.
   • Reinsert inner cannula, turning to lock it in place.

5. Complete the procedure.
   • Cleanse area around trach and stoma with saline or hydrogen peroxide. Assess appearance of skin as you clean and dry the area.
   • Apply new trach dressing by sliding slit gauze sponge under the tracheostomy tube after gently removing old trach dressing.
   • Replace neck tapes if needed according to facility policy. Lace new tapes through tracheostomy sides before removing old tapes if possible. If using commercially prepared tracheostomy tube holder, open package according to manufacturer’s directions. If not, have a second person hold the trach securely in place while you remove old ties and apply new ones.
   • Remove all used equipment and dispose of it according to agency policy.
   • Leave patient comfortable and safe.
   • Document that trach care was given, appearance of the stoma, and patient’s response to procedure.
LEARNING OBJECTIVES

Objective Discuss basic techniques of chest tube management.

Objective Demonstrate the ability to provide care for a patient with a chest tube.

CHEST TUBE MANAGEMENT

A chest tube insertion is a procedure to place a flexible, hollow drainage tube into the chest in order to remove an abnormal collection of air or fluid from the pleural space.

Chest tube insertions are usually performed as an emergency procedure. Chest tubes are used to treat conditions that can cause the lung to collapse, which occur because blood or air in the pleural space can hamper the ability of a patient to breathe.

Three common conditions can require surgical chest tube insertion, including:

- **Pneumothorax** (air leak from the lung into the chest)
- **Hemothorax** (bleeding into the chest)
- **Empyema** (lung abscess or pus in the chest)

NOTE: Pneumothorax or hemothorax can occur after surgery or from trauma to the chest.

Patients with chest tubes have a water-sealed drainage system in place. The water-sealed drainage system has two or three collection compartments. This system evacuates air or blood from the pleural cavity and allows the affected lung to re-inflate. One chamber collects blood or air as it is evacuated from the pleural space. The second compartment holds water that prevents air from re-entering the pleural space and the third chamber (if used) facilitates the use of suction.

When caring for or assisting the patient to reposition, the nurse must ensure that the chest tube remains in the drainage system unless it is clamped off.
Care for Patient with a Chest Tube

1. **Prepare for pre-insertion assessment, intervention and documentation.**
   - Assess patient’s breath sounds, heart rate, blood pressure, temperature, respiratory rate and rhythm, and O₂ saturation.
   - Assess patient allergies.
   - Assure O₂ and suction is available at bedside.
   - Instruct the patient regarding the purpose of the procedure, what to expect, and signs and symptoms to report.
   - Administer ordered analgesia as needed.
   - Verify facility’s policy regarding the use of automatic vital sign recorder during this procedure.
   - Document assessment results.
   - Document patient teaching.
   - Assist the physician as needed.

2. **Post insertion**
   - Immediately after insertion, assess insertion site, location, and tube size.
   - Immediately after insertion and every four hours while chest tube is in place, assess drainage collection system for fluctuations and air bubbles in air leak indicator, and set suction at ordered level.
   - Immediately after insertion, every four hours while chest tube is in place, and immediately after removal of chest tube assess:
     - Comfort level
     - Breath sounds, heart rate, blood pressure, temperature, respiratory rate and rhythm and O₂ saturation
     - Drainage for amount, color, and consistency
     - Dressing for occlusiveness and drainage from insertion site
     - Chest wall at insertion site for subcutaneous emphysema
   - While chest tube is in place and drainage collection system is in use, mark volume of drainage including date, time, and initial every shift.

3. **Interventions**
   - Assure chest x-ray is obtained after insertion and after removal.
   - Verify patient knows potential complications and what to do should they occur.
   - Position the drainage system in upright position, below level of the heart at all times.
   - Place emergency equipment in patient’s room (bottle of sterile NS, 4 x 4, Vaseline gauze, tape and non-toothed padded clamps).
   - Assure that extra drainage collection system is readily available on the unit.
   - Reposition patient every two hours.
   - Change dressing every day or more frequently, if it becomes soiled, saturated, loose, or as otherwise instructed by prescriber.

4. **Final Steps**
   - Remove equipment, leaving area neat and clean.
   - Leave patient comfortable with side rails up, call light available, and tissues close by.
   - Document the appearance of the stoma.
   - Document the patient’s response to the procedure.

**NOTE:** Never clamp a chest tube, except momentarily, when:
   - Changing the chest tube system
   - Assessing for location of air leak
   - Assessing patient’s tolerance of chest tube removal
KEY SUMMARY

❖ Nurses must continually assess the patient’s respiratory status regardless of the patient’s diagnosis or complaints.

❖ Appropriate intervention helps insure the patient has no respiratory complications.

❖ Chest physical therapy includes a number of treatments that improve respiratory efficiency, promote expansion of the lungs, strengthen respiratory muscles and eliminate secretions. Included in these treatments are postural drainage, percussion, vibration, turning, deep breathing, coughing, and incentive spirometry.

❖ Pulse oximetry is a simple non-invasive method to monitor the percentage of hemoglobin that is saturated with oxygen.

❖ There are a variety of methods and administration devices for providing oxygen therapy for patients. Nurses must be proficient in administering oxygen through numerous devices.

❖ Nurses must be able to do a throat culture quickly and with little trauma to the patient.

❖ Nurses must be able to instruct a patient to obtain a sputum specimen so that the specimen will be appropriate for testing and not a sample of saliva.

❖ Removing secretions from the throat instead of from the nostrils is frequently the least traumatic means of suctioning for the patient.

❖ Chest tube placement is an emergency procedure that provides immediate relief for a patient suffering a pneumothorax.
GLOSSARY

Atelectasis: State in which the lung, in whole or in part, is collapsed or without air.

Auscultation: Listening to breath sounds via a stethoscope.

Blanched: Apply and quickly release pressure to a fingernail or toenail to determine circulatory status of the patient.

Chest physical therapy: Techniques for increasing respiratory efficiency, promoting expansion of the lungs, strengthening respiratory muscles and eliminating secretions.

Empyema: Lung abscess or pus in the chest.

Endotracheal: Within or passing through the trachea.

Face tent: Oxygen administration device that provides oxygen around the nose and mouth.

Gastric Esophageal Reflux Disease (GERD): A chronic condition in which acid from the stomach flows back into the lower esophagus, causing pain or tissue damage.

Hemoglobin: The oxygen-carrying pigment of red blood cells that gives them their red color and serves to convey oxygen to the tissues; occurs in reduced form (deoxyhemoglobin) in venous blood and in combination with oxygen (oxyhemoglobin) in arterial blood.

Hemothorax: Fluid or blood pooling in the pleural cavity; also called pleural effusion.

Hypoxia: Inadequate oxygen level in the cells.

Incentive spirometry: Technique for deep breathing using a calibrated device to measure depth of breaths.

Intracranial Pressure (ICP): The pressure of fluid in the space between the skull and the brain and around the spinal cord.

Mechanical respiration: Artificial respiration. A procedure used to restore or maintain respiration in a patient who has stopped breathing.

Mucus: Substance that keeps the mucous membranes moist.

Nasal cannula: Oxygen administration device; hollow tube with prongs that are placed into each nostril for delivering oxygen.
Nasal catheter: Oxygen administration device; hollow tube that goes into and through the nostril of the patient.

Nasopharyngeal suctioning: Removing secretions from the nose via suction device.

Obturator: Anything that obstructs an opening or cavity.

Oropharyngeal suctioning: Removing secretions from the throat through the mouth via suction device.

Oxygen concentrator: Machine that collects and concentrates oxygen from room air.

Oxygen therapy: Intervention that delivers more oxygen than is found in the atmosphere.

Oxygen toxicity: Lung damage caused when oxygen concentration of more than 50% is administered for 48-72 hours.

Percussion: Type of chest physical therapy provided by tapping parts of body with cupped hands.

Pneumothorax: Air leak from the lung into the chest.

Postural drainage: Position that provides optimum drainage of fluids from lungs.

Pulse oximetry: Non-invasive technique for monitoring amount of oxygen in hemoglobin.

Pursed lip breathing: Conscious breathing technique that prolongs expiration.

Subcutaneous emphysema: Air that is in the subcutaneous tissue.

Suctioning: Technique that removes liquid secretions with a catheter.

Tracheostomy: Surgically-created opening into the trachea.

Tracheostomy collar: Delivers oxygen via an artificial opening in the neck.

Tracheostomy tube: Hollow tube placed in the trachea.
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