



## *Nursing Professional Development*

# *Chest Tube Insertion, Maintenance and Removal*

## *Resource Manual*

*Quality, Patient Safety & Interprofessional Practice August 2020*



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## Certification Criteria

RNs and RPNs in all areas will assist with insertion and maintenance of chest tubes, once they have read the self-learning manual entitled “Chest Tube Insertion, Maintenance and Removal.”

**ONLY ICU RNs** will be allowed to **remove** chest tubes, upon the **order** of a physician, after completing the following certification process:

- Read the self-learning manual entitled Chest Tube Insertion, Maintenance and Removal.
- Achieve 80% or greater on the Chest Tube Removal certification test (Appendix B).
- Supervision by a certified nurse who has achieved and maintained competence in this skill and sign off of the skills checklist for Chest Tube Removal (Appendix A).

## Continuing Competence

It is strongly recommended that the certified nurse review all skills related to the care and maintenance of chest tubes on an ongoing basis to ensure continued competence. If at any time the nurse feels additional review/retraining is required, it is the responsibility of that nurse to seek additional education/resources from the manager, or clinical educator/delegate to ensure continued competence related to chest tube care and maintenance. Nurses are professionally responsible for ensuring that they have the requisite knowledge, skill and judgment necessary to provide safe and effective care. (CNO, 2002)

## Introduction

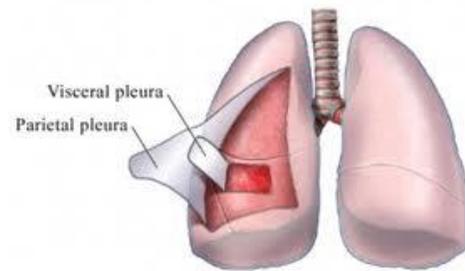
### What is a Chest Tube?

1. A chest tube is a hollow, flexible tube placed into the chest. It acts as a drain. Chest tubes drain blood, fluid, or air from the pleural space. The tube is placed between the ribs and into the space between the lining of the lungs and the lining of the wall of the chest cavity.
2. A chest tube is inserted when the presence of air and/or fluid between the lining of the lungs and the chest wall compromises the patient's ability to expand the lung and to exchange oxygen and carbon dioxide.
3. Chest tubes come in various sizes. Larger trochars are used in cases of chest trauma and smaller pigtail chest tubes are used for smaller pneumothorax or smaller pleural fluid collections.
4. Chest tubes are inserted using local anaesthetic and sterile technique.
5. There are a few common insertion sites, depending on what lung field is affected, and whether it is a pneumothorax or a pleural effusion. At QHC we do not insert mediastinal chest tubes, which are generally inserted following cardiothoracic surgery. The most common insertion sites are the 2<sup>nd</sup> or 3<sup>rd</sup> intercostal space in the mid-clavicular/anterior axillary line, for the evacuation of air (pneumothorax) or the 5<sup>th</sup> or 6<sup>th</sup> intercostal space in the mid-axillary line for the evacuation of fluid (pleural effusion).
6. Assisting with insertion and maintaining chest tubes are within the scope of practice for nurses at QHC. However, only **certified ICU nurses** may perform chest tube removal.
7. In order to demonstrate competency in the removal of chest tubes, the certified ICU nurse will:
  - Conduct a thorough nursing assessment of a patient who has a pleural chest tube and confirm criteria for removal, i.e., lung expansion, resolution of an air leak, and decreased fluid drainage.
  - Obtain and confirm the presence of a written physician's order.
  - Assess the patient's comfort level and ensure the provision of analgesia as necessary.
  - Educate the patient in the appropriate breathing sequence for chest tube removal and assist the patient to practice prior to removal.
  - Remove the chest tube.
  - Conduct a thorough nursing assessment of a patient following chest tube removal.
  - Document relevant information and communicate concerns/problems to the MRP.

## Anatomy: The Respiratory System

### Pleurae and Pleural Space

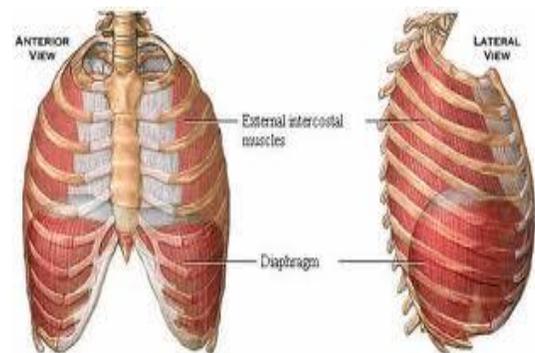
Each lung is covered with two pleural membranes. The inner layer, or that which covers the surface of the lung, is called the **visceral pleura** and it is inseparably attached to the lung surface. The **parietal pleura** line the internal surface of the thoracic wall, the lateral surface of the mediastinum, the superior surface of the diaphragm, and the apices of the lungs. These two pleurae are continuous with one another and form a closed sac.



Both the visceral and parietal pleura have a blood supply and a lymphatic supply through which they secrete and absorb fluid. The surfaces of the visceral and parietal pleura are moistened by minimal amounts of serous fluid (surfactant). The potential space between the visceral and parietal pleura is termed the **pleural cavity** or pleural space. This space is a ‘potential space’ because it has the capacity or ‘potential’ to hold a large amount of fluid but, due to constant secretion and absorption, only about 10-20 mL of pleural fluid remains in the pleural space at any one time. This fluid lubricates the pleural surfaces so that they move smoothly against each other during inspiration and expiration.

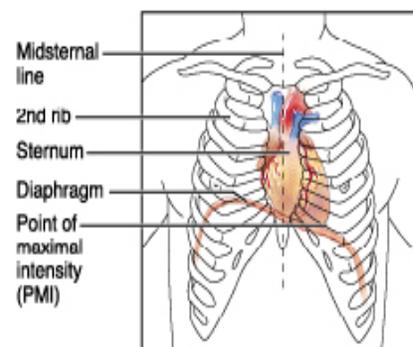
### Diaphragm and Intercostal Muscles

The **diaphragm** is the main muscle of respiration and is innervated by the phrenic nerve. It stretches across the bottom of the thorax, separating the thoracic cavity from the abdominal cavity. The **external intercostal muscles** extend from one rib to the rib below and assist during the inspiratory phase of ventilation. The function of the external intercostal is to draw the ribs upward and outward to enlarge the anterior-posterior diameter of the thoracic cavity and increase lung volumes.



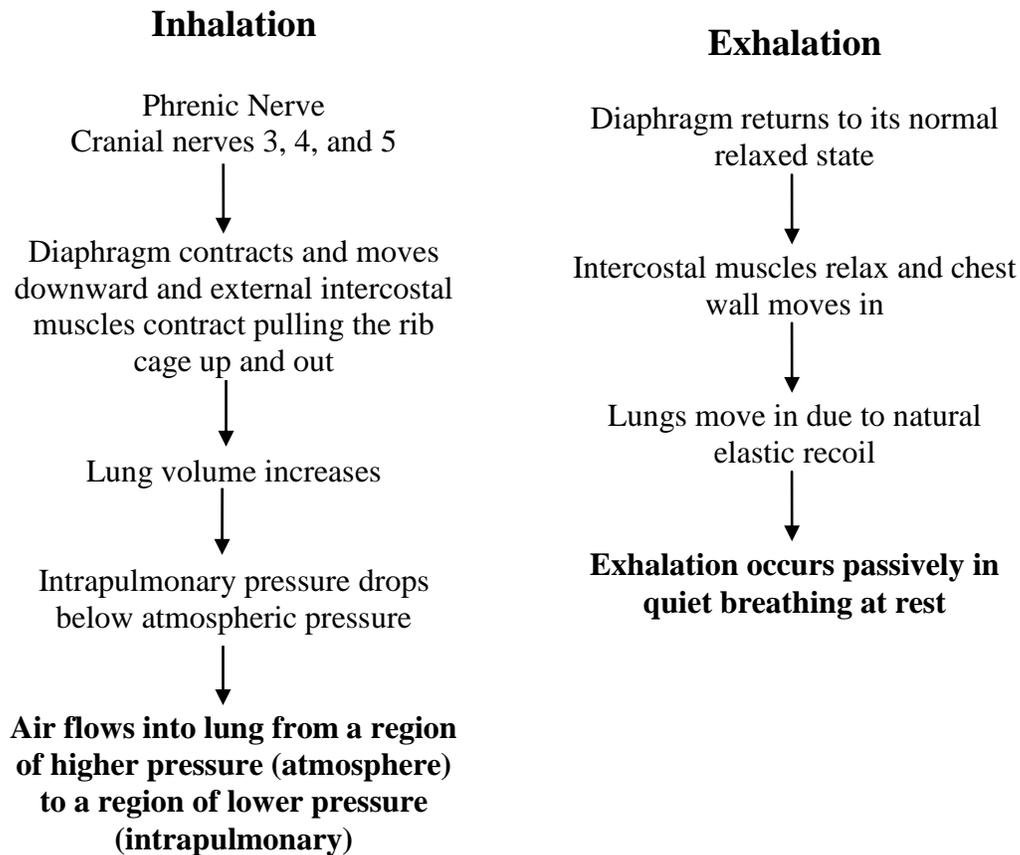
### Mediastinum

The **mediastinum** lies in the middle of the thorax between the two pleural sacs that contain the lungs and directly behind the sternum. The superior aspect of the mediastinum is the thoracic inlet (first thoracic vertebra) with the inferior aspect formed by the diaphragm. The mediastinum includes the heart, great vessels (aorta and superior vena cava), thymus, vagus, and phrenic nerves, lymph nodes, thoracic ducts, and part of the esophagus and trachea.



## Ventilation

The primary function of the respiratory system is the exchange of carbon dioxide and oxygen which requires ventilation of the lungs, perfusion of the lungs, and diffusion of gases between the capillaries of the lungs and the alveoli. Ventilation is the mechanism by which air gets to and from the alveoli and requires adequate lung volume, patent airway passages, normal nervous system control of breathing and effective bellows action of the chest.



The inspiratory phase of ventilation is an active process; the intercostal muscles move the diaphragm to expand the lungs. Normal exhalation is a passive process because of the natural elasticity and recoil of the lungs, pulling the diaphragm back into place. When disease destroys or alters the elasticity of the lungs or ventilatory demand increases, abdominal muscles are required to achieve active expiration.

The lungs are kept from completely collapsing during exhalation by the residual air volume that remains in the lungs and a negative pressure (vacuum effect) between the two pleurae that maintain partial lung expansion. The inter-pleural negativity changes during the respiratory cycle and keeps the lung partially expanded and pulled against the chest wall. Normally, during inhalation the inter-pleural pressure is more negative than during exhalation. It is vitally important that the two pleura remain in contact with each other. Anything that breaks the contact of the two pleura (air or fluid) will also break the negativity that keeps the lung expanded.

## Indications for a Chest Tube

### Pneumothorax

A pneumothorax results from free air in the pleural space causing partial or complete lung collapse.

A pneumothorax can be:

**Closed:** Air enters the pleural space through a rupture in the lung itself. The chest wall remains intact. This can be:

- Spontaneous - results from a weakened area on the lung surface from disease such as emphysema or cystic fibrosis or can occur in individuals with no known lung disease (most commonly seen in the adolescent male during a growth spurt)
- Traumatic - tear of pleura and/or bronchi as a result of blunt chest injury
- Iatrogenic (results from invasive therapies/procedures such as central line insertion, drainage of pleural effusion)

Signs and Symptoms:

- Sudden sharp chest pain
- Dyspnea
- Asymmetric chest movement
- Diminished or absent breath sounds on affected side
- Subcutaneous emphysema around neck

**Open (Sucking):** Air enters the pleural space through an opening in the chest wall. This may also include penetration of the visceral and/or parietal pleura. Common causes include gunshot and stab wounds.

Signs and Symptoms:

- Sudden pain
- Dyspnea/air hunger
- Cyanosis
- Sucking sound
- Use of accessory muscles
- Tachypnea
- Decreased chest excursion on affected side
- Decreased or absent breath sounds

**Tension:** Progressive air trapping in the pleural space. It can occur from mechanical ventilation or prolonged chest tube clamping which compresses the lung. A tension pneumothorax can cause a mediastinal shift and is a **life-threatening situation**.

Signs and Symptoms:

- Severe dyspnea and/or cyanosis
- Chest pain, tachycardia
- Mediastinal shift (may include tracheal deviation)
- Cardiac arrhythmias
- Hypotension
- Distended neck veins

## Pleural Effusion

A pleural effusion results from the collection of fluid in the pleural space. This fluid may be:

**Transudative**: A watery capillary fluid. It is usually bilateral and occurs with a variety of conditions (congestive heart failure, hepatic disease, nephrotic syndrome).

Signs and Symptoms:

- Diminished/absent breath sounds on affected side
- Dyspnea
- Chest pain
- Tachycardia
- May be asymptomatic

**Exudative**: Protein rich fluid. It is usually unilateral and occurs with many clinical conditions (cancer, infection, pancreatitis, connective tissue disease).

Signs & Symptoms: (same as transudative)

**Hemothorax**: Collection of blood. It may be caused by trauma to chest wall, pulmonary infarct, pulmonary/pleural neoplasm, diaphragm laceration/rupture, or cardiovascular surgery.

Signs and Symptoms:

- Diminished or absent breath sounds on affected side
- Asymmetric chest movement
- Dyspnea
- Chest pain
- Tachycardia
- Diaphoresis
- Hypotension
- Signs of circulatory collapse

**Empyema**: Purulent fluid. It is caused by an infectious process. The diagnosis is made through thoracentesis with fluid sent for culture and sensitivity. Drainage can take weeks to months

Signs and Symptoms:

- pleuritic type chest pain
- productive cough, fever, and shortness of breath

## Types of Chest Tubes

Chest tube sizes range from large bore (greater than or equal to 20F) to small bore (less than 20F).

Trochar – used for trauma or larger fluid/air collections:



Figure 1

Large-bore chest drain insertion modalities. (A) The trocar technique; (B) blunt dissection.

The most common drawbacks of large bore chest tubes are pain, which is directly related to the traumatic insertion of the tube through the intercostal space, and its size. There may be increased risk of infection with longer-dwelling large bore tubes.



Cook -Wayne Pneumothorax Kit 14 French with large drainage holes. Stopcock must be maintained in **OPEN** position, unless briefly clamping (turn OFF to patient) to change pleurevac or drainage bag.

Used for smaller pneumothorax, uncomplicated empyema, malignant or chronic pleural effusions and are often inserted under ultrasound guidance, pigtail chest tubes are less painful to insert and easier to tolerate for the patient; therefore they are becoming more widely used. Larger sized drainage holes help prevent occlusion.



Attach to PleurevacDrainage System

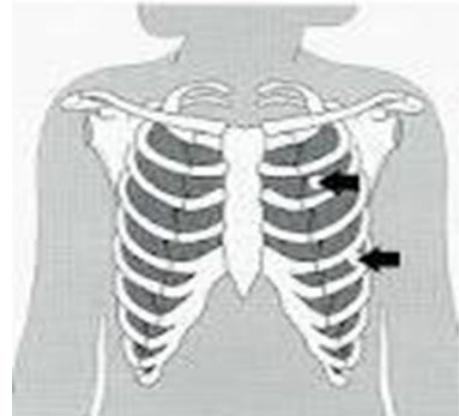
Attach to HeimlichValve

## Chest Tube Placement

Chest tubes are inserted using local anaesthetic and sterile technique.

Insertion of a chest tube for the **evacuation of air (pneumothorax)** is normally at the 2<sup>nd</sup> or 3<sup>rd</sup> intercostal space on the affected side along the mid-clavicular or anterior axillary line.

Insertion of a chest tube for the evacuation of fluid (pleural effusion) is normally at the 5<sup>th</sup> or 6<sup>th</sup> intercostal space in the mid-axillary line.

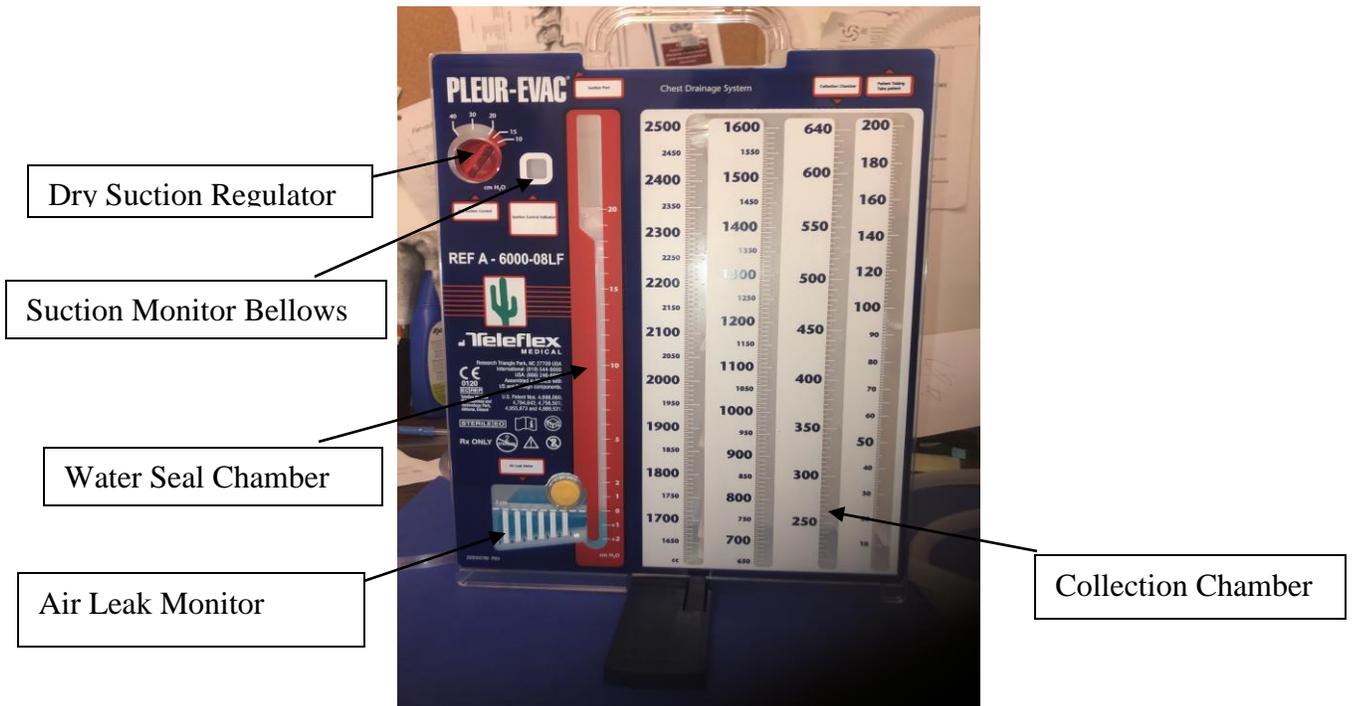


Mediastinal chest drains (including pericardial drains) are inserted as standard postoperative practice following cardiac surgery to assist the clearance of blood from the pericardial space. We do not insert mediastinal chest tubes at QHC.

## Chest Tube Drainage Systems

A chest tube can be inserted for drainage of fluid and in that case, may be left to straight drainage, according to physician order. If so, a collection device, either a bag or a pleurevac drainage system may be used, without connecting the pleurevac to the wall suction.

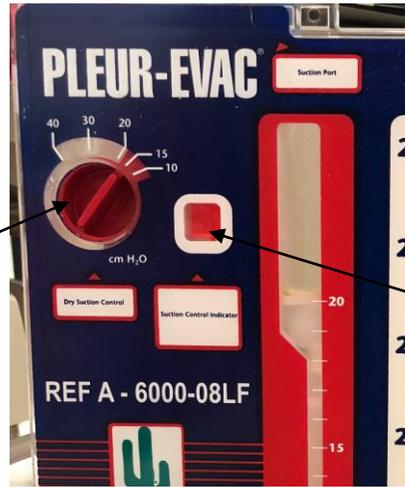
Chest tubes inserted for pneumothorax **MUST** be connected to wall suction at all times. The failure to maintain suction may result in a worsening pneumothorax or a tension pneumothorax and is a serious medical emergency.



NOTE: Air Leak Monitor: minor bubbling will be seen when air is being evacuated from the pleural space; this is normal for pneumothorax initially and the amount of bubbling in the air leak

indicator will decrease as the pneumo resolves. Patients with a pneumothorax will require connection of the pleurevac to a suction source at all times. Excessive, vigorous bubbling indicates an air leak and steps must be taken to troubleshoot the leak (see page 15/16).

Adjust suction control as ordered by Physician (i.e. 20 cm H<sub>2</sub>O).  
The wall suction regulator will need to be at minimum 80 mmHg and may need to be higher. The pleurevac system regulates the pressure within the system regardless of the wall suction setting. Use enough wall suction to ensure the orange bellows is visible in the indicator window.

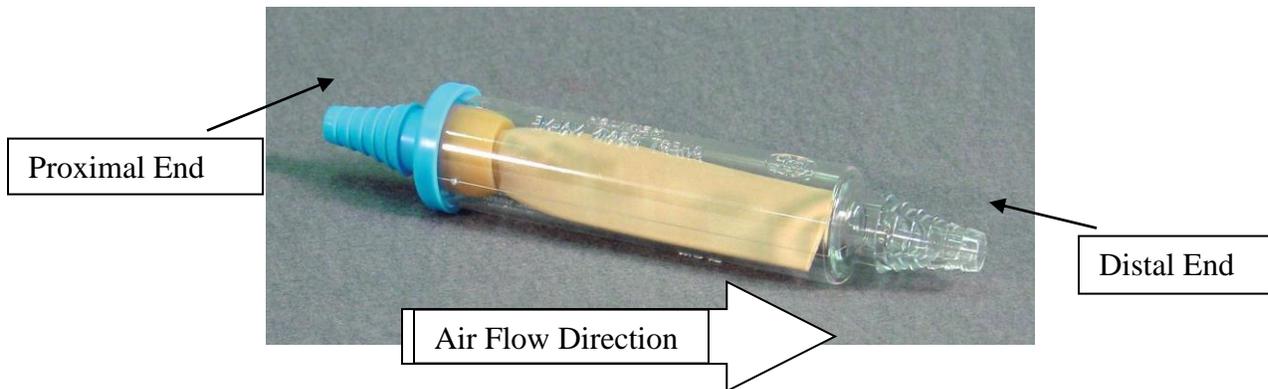


Orange Suction Bellows Indicator must be visible when suction is in use. Orange Bellows will not be visible if the pleurevac is not connected to a suction source (i.e. for straight drainage)

To watch a video on setting up and using the Pleurevac Chest Tube Drainage System, type the link below into the URL address bar on your internet search engine:  
<https://www.youtube.com/watch?v=OlzXZck3iw>

### Heimlich Valve

Created in the 1960's this small plastic portable one-way valve allows for the removal of air from the pleural space when a traditional drainage system is unnecessary or when the pneumothorax is small enough that the patient may be discharged home from hospital with a Heimlich valve. The patient will require a follow up chest x-ray prior to removal of the chest tube, to ensure the pneumothorax has resolved completely. The device consists of a length of rubber tubing that is flattened at one end and encased in a plastic cylinder. On inspiration the valve collapses preventing air from re-entering the pleural space and on expiration the valve opens to allow air to escape. The fluttering action of the valve will continue as long as there is air in the pleural space. The proximal (blue end) is connected to the chest tube and **securely** taped to prevent disconnection. The distal end of the valve is the atmospheric vent and must remain open at all times.



## Chest Tube Insertion Procedure

- The physician will select the insertion site and chest tube size to be inserted
- Generally large bore tubes are inserted for fluid evacuation and smaller bore tubes are inserted for air evacuation
- The physician will inject local anaesthetic at the insertion site
- Chest tube insertion is a painful procedure thus intravenous analgesics will likely be utilized prior to and during the procedure
- Because the pleura are sensitive and difficult to anaesthetize the patient may be uncomfortable despite analgesic; providing emotional support is essential
- The chest tube is sutured to the chest wall and connected to the drainage system
- A chest x-ray is required to confirm placement

## Equipment for Chest Tube Insertion

- Sterile gloves, mask and gown
- Clear adhesive waterproof tape for taping connections
- Occlusive Dressing Supplies: Adaptic, preferably petrolatum-infused, 4x4 gauze pads, Abdominal pad, Hypafix
- Chest Tube Insertion Tray including: sterile towels, scalpel, Kelly clamp, curved Kelly clamp, small sponge forceps, needle holder, suture scissors, 4x4 gauze, 10 cc syringe, 25 gauge 5/8” needle, 18 gauge 1 ½” blunt needle, “0” silk suture
- Rubber tipped hemostat
- Lidocaine 1%
- Chlorhexadine solution
- Pleurevac Drainage system, suction tubing, suction regulator, and fluid collection container set up to wall suction

## Assisting with Chest Tube Insertion

- Perform hand hygiene and apply clean gloves
- Explain procedure to patient and provide support to the patient during insertion
- Position the patient as directed by the physician
- Open the tray observing sterile technique and add chlorhexadine, syringes, rubber tipped Kelly clamp and needles and chest tube (size determined by Physician)
- Set up Pleurevac drainage system, fill water seal chamber with distilled water to 2cm mark, hook up system to wall suction and ensure all suction tubing connections are well secured
- Hold Lidocaine bottles for Physician to withdraw
- If lab samples of chest fluid drainage are required, collect them before attaching to pleurevac drainage system
- After chest tube is inserted, attach to pleurevac drainage system and secure connections with waterproof tape
- Apply occlusive dressing to insertion site and secure chest tube to patient to protect against inadvertent pulling and dislodgement of the tube. Maintain dressing for at least 48 hours and do not change, reinforce if bloody or wet. Routine dressing changes are q72 hours thereafter unless otherwise ordered by Physician
- Chest x-ray is required to confirm tube placement

## Nursing Interventions

### Pre-Insertion:

- Obtain and document baseline vital signs including oxygen saturation (S<sub>p</sub>O<sub>2</sub>) and level of consciousness (LOC)
- Know the patient's hemoglobin and hematocrit levels
- Perform respiratory assessment including auscultation of lung sounds, signs and symptoms of respiratory distress, pain
- Confirm patient medication allergies and two patient identifiers
- Administer pre-medication analgesics and/or sedation as ordered by Physician
- Set up Pleurevac and ensure wall suction system working
- Set up Procedure Tray maintaining sterility
- Assist with procedure and provide emotional support to patient

### Post-Insertion:

- Ensure connections are securely taped with waterproof tape
- Apply occlusive dressing over insertion site
- Adjust suction control on Pleurevac system and ensure it is functioning properly, if not initiate troubleshooting procedures (see section on troubleshooting)
- Obtain and document patient's vital signs including S<sub>p</sub>O<sub>2</sub> and level of consciousness, lung sounds, insertion site dressing and pain level q15 minutes for 2 hours
- Document amount and color of drainage in chest tube system
- Inspect water seal for fluctuations with patient's inspiration and expiration
- Monitor for drainage that becomes bright red or more than 100 mL/hr of bloody drainage after the first few hours post-insertion, notify Physician
- Monitor for potential development of tension pneumothorax indicated by increased respiratory distress, chest pain, tachycardia, decreased oxygen saturation, absence of breath sounds on the affected side, late signs of hypotension, tracheal shift

## Daily Assessments

When caring for a patient with a chest tube perform the following **assessments every shift**:

1. Assess insertion site: For the first 48 hours the chest tube insertion site dressing is maintained. If dressing is wet with blood or drainage reinforce the dressing and report to the Physician. Inspect regularly to ensure dressing is dry and intact. After 48 hours, change the occlusive dressing. Inspect the site for bleeding, leakage, redness while site is exposed. Following initial dressing change, subsequent dressing changes are q72 hours and PRN.
2. Assess drainage system tubing to ensure it is not kinked and drainage is able to empty into collection container. Document the total drainage per shift.
3. Assess the Pleurevac system to ensure that there is water seal fluctuation with patient's inspiration and expiration. The water seal rises with inspiration and falls with expiration (this is opposite when the patient is mechanically ventilated). For pneumothorax it is normal to see some minimal bubbling in the air leak monitor fluid as the pneumo is resolving. Excess bubbling in the system is not normal and may indicate a problem with the system or an air leak at the insertion site, tubing, connections or the Pleurevac system itself. (See troubleshooting section.)

## Clamping the Chest Tube

A chest tube is **only** clamped in specific situations:

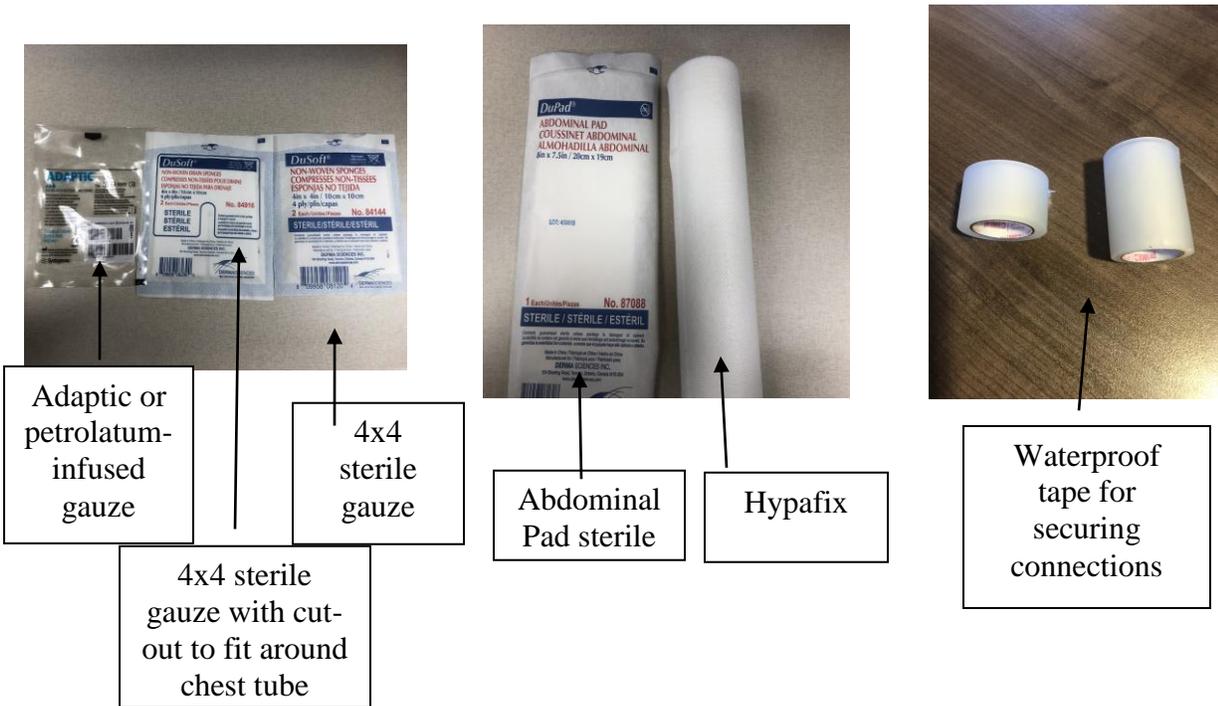
1. The changing of the drainage system
2. On the order of the physician, when assessing for resolution of the pneumothorax

When changing the Pleurevac drainage system:

1. Set up the new system completely prior to clamping and disconnecting the chest tube.
2. Turn off wall suction
3. Slide blue clamp closed on tubing
4. Disconnect the old drainage system at the in-line connector and attach the new system
5. Slide blue clamp open
6. Turn on suction
7. Document

If a tube is clamped on the order of a physician to assess the pneumothorax, the frequency of assessment and vital signs will increase. In addition, if any deterioration is observed while a chest tube is clamped it should be IMMEDIATELY unclamped and the physician notified.

## Dressing Supplies



## Procedure: Changing the Chest Tube Dressing

Procedural Step	Rationale
1. Gather supplies <ul style="list-style-type: none"> <li>• Gloves</li> <li>• Dressing tray</li> <li>• Chlorhexidine</li> <li>• 4x4 gauze with y cut (trach gauze)</li> <li>• 4x4 gauze</li> <li>• Hypafix</li> </ul>	
2. Perform hand hygiene before donning gloves	<ul style="list-style-type: none"> <li>• Hand hygiene is performed prior to donning PPE to reduce the number of microorganisms on the care providers skin and prevent transfer to the patient</li> </ul>
3. Confirm you have the correct patient by performing the 2 Patient Identifier process.	<ul style="list-style-type: none"> <li>• 2 Patient Identifier Process is a Required Organizational Procedure (ROP) and ensures the right care is provided to the right patient at the right time</li> </ul>
4. Explain procedure to the patient	<ul style="list-style-type: none"> <li>• Information provided reduces patient anxiety</li> </ul>
5. Remove old dressing	<ul style="list-style-type: none"> <li>• Observe old dressing for color and amount of drainage</li> <li>• Observe site for signs of infection, presence of subcutaneous emphysema</li> </ul>
6. Cleanse site with chlorhexidine and allow to dry completely	<ul style="list-style-type: none"> <li>• The bactericidal action of chlorhexidine takes place during the drying time</li> </ul>
7. Apply adaptic around tube insertion site, then place y-cut gauze around tube, layer with regular 4x4 gauze and abdominal pad. Cover entire dressing with hypafix.	<ul style="list-style-type: none"> <li>• Adaptic applied around insertion site helps prevent air entry into chest wall</li> <li>• Layers provide occlusive dressing</li> </ul>
8. Document: <ul style="list-style-type: none"> <li>• Drainage on old dressing</li> <li>• Skin condition</li> <li>• New dressing applied</li> <li>• Patient tolerance to procedure</li> </ul>	Documentation provides an accurate and timely reflection of the care provided

## Troubleshooting Chest Tubes

Problem	Cause(s)	Nursing Intervention
Sudden slowing/cessation of drainage	Chest tube blocked by a clot or a kink in the tubing	<ul style="list-style-type: none"> <li>• Check tubing for kinks</li> <li>• Avoid dependent loops in the drainage tubing</li> <li>• Turn patient on affected side to facilitate drainage</li> <li>• If a clot is visible alternately squeeze and release (milking) small segments of the tubing</li> </ul> <p><b>*milking the tubing is a last resort and if possible the tubing should be changed* *milking causes unnecessary increased intrathoracic pressure*</b></p>
Air Leak	Air is leaking from the lung (intermittent bubbling during exhalation or inhalation if patient is ventilated). A small amount of intermittent bubbling is normal.	<ul style="list-style-type: none"> <li>• Maintain integrity of tubing</li> <li>• This is a normal finding so long as the chest tube has been inserted to treat a pneumothorax</li> </ul>
	Air leaking from insertion site	<ul style="list-style-type: none"> <li>• Ensure the tube has been sutured well in place</li> <li>• Reinforce occlusive dressing</li> <li>• Notify physician</li> </ul>
	Air leaking from loose connections (continuous bubbling with no water seal fluctuations)	<ul style="list-style-type: none"> <li>• Briefly pinch off a section of tubing closest to the insertion site. If bubbling stops the air leak may be from the connections/tubing. Keep moving the clamp 8-10cm and re-clamp to see if the bubbling stops in order to locate the air leak.</li> <li>• If bubbling continues after temporarily clamping the tube a system replacement may be necessary</li> <li>• Ensure connections are taped securely</li> </ul>

	Chest tube falls out	<p>If air leak is present:</p> <ul style="list-style-type: none"> <li>• Apply gauze dressing “windowed” on 3 sides</li> <li>• Allows air to exit pleural space during exhalation and prevents air trapping during inhalation as hole is sealed by dressing on inhalation</li> <li>• Notify MD STAT</li> <li>• Prepare for chest tube re-insertion if necessary</li> </ul> <p>If air leak absent:</p> <ul style="list-style-type: none"> <li>• Apply occlusive dressing</li> <li>• Notify MD STAT</li> </ul>
High negative pressures in water seal chamber	Deep breathing, vigorous coughing, anxiety, pain	<ul style="list-style-type: none"> <li>• Monitor patient</li> <li>• The Pleurevac system has a negative pressure relief valve that automatically releases air if excess pressure builds up</li> <li>• Provide analgesia/anxiolytic</li> <li>• Check tubing for obstruction/kinks</li> <li>• Notify physician – may require chest x-ray to confirm tube placement</li> </ul>
Fluctuation of fluid level in water-seal chamber	Reflects normal pressure changes in the pleural cavity during breathing	<ul style="list-style-type: none"> <li>• Maintain correct fluid level in air leak detector chamber (2 cm water)</li> </ul>
Pneumothorax progressing to tension pneumothorax	Air trapping in pleural space: kink in tubing or tubing inadvertently clamped	<ul style="list-style-type: none"> <li>• Release any kinks in tubing</li> <li>• Remove clamp if present</li> <li>• Notify MD STAT</li> <li>• Assess air bubbling in water-seal chamber</li> </ul>
Patient experiencing pain and anxiety	Position of chest tube(s)	<ul style="list-style-type: none"> <li>• Provide analgesia/sedation as appropriate</li> <li>• Change patient position</li> </ul>

## Chest Tube Complications

Complication	Causes	Prevention	Nursing Responsibilities
Subcutaneous Emphysema	Air entering the subcutaneous tissue		<ul style="list-style-type: none"> <li>• Observe regularly for puffing out of the skin</li> <li>• Observe and palpate around insertion site for “Rice Krispies” like effect under the skin</li> <li>• Notify MD if not already aware or if an increase is noted post chest tube insertion</li> <li>• Mark the area with a skin marker so that progression of the subcutaneous emphysema will be measurable</li> <li>• Treat the cause of the air leak and the subcutaneous emphysema will slowly resolve</li> </ul>
Bleeding	Complication at the time of insertion (vessel nicked)		<ul style="list-style-type: none"> <li>• Generally minor and resolves on its own</li> <li>• Monitor drainage and report a change to sanguinous drainage</li> <li>• Auscultate lung fields to identify changes in air entry</li> </ul>
Infection	Break of sterile technique or prolonged use of chest tube	<ul style="list-style-type: none"> <li>• Utilize sterile technique when system is open and during insertion</li> <li>• Maintain an intact dressing</li> </ul>	<ul style="list-style-type: none"> <li>• Notify physician of suspected infection</li> <li>• C and S of insertion site may be ordered</li> </ul>

Disconnection	<ul style="list-style-type: none"> <li>• Loose connections</li> <li>• Poorly secured connections</li> </ul>	<ul style="list-style-type: none"> <li>• Tape all connections with waterproof tape</li> <li>• Check connections each shift</li> </ul>	<ul style="list-style-type: none"> <li>• Keep 500mL of sterile water at the bedside at all times</li> <li>• Clamp the chest tube near the insertion site with rubber tipped clamps</li> <li>• Submerge distal end of chest tube in sterile water</li> <li>• Unclamp chest tube when distal end is completely submerged</li> <li>• <b>Remain with the patient</b> and have another colleague obtain and set-up a new drainage system</li> <li>• Re-clamp chest tube</li> <li>• Connect chest tube to new drainage system</li> <li>• Un-clamp chest tube</li> <li>• Apply suction as ordered</li> <li>• Notify physician of the event</li> </ul>
Dislodgement of Chest Tube	<ul style="list-style-type: none"> <li>• Accidental removal or chest tube</li> </ul>	<ul style="list-style-type: none"> <li>• Secure dressing</li> </ul>	<ul style="list-style-type: none"> <li>• Cover site</li> </ul> <p>If no active air leak:</p> <ul style="list-style-type: none"> <li>• Have patient perform maximal exhalation</li> <li>• Cover site with petrolatum-infused gauze and apply occlusive dressing</li> </ul> <p>If active air leak:</p> <ul style="list-style-type: none"> <li>• Cover site with dressing and tape 3 sides periodically lifting the un-taped side during exhalation</li> <li>• Obtain vital signs and perform respiratory assessment</li> <li>• <b>Notify physician immediately</b></li> </ul>

## Chest Tube Removal

Chest tubes are generally removed when there is less than 150 mL of drainage in 12 hours and no air leak for 24 to 48 hours. Chest tube removal requires a physician order and will be done by the physician, or within the ICU, by a certified ICU Nurse.

### Chest Tube Removal – Certified ICU RN Only\*

The certified ICU nurse will:

1. Conduct a thorough nursing assessment of the patient who has a chest tube and confirm the criteria for removal including lung re-expansion, resolution of the air leak and decreased fluid drainage has occurred.
2. Confirm the presence of a written physician's order.
3. Assess the patient's comfort level and ensure the provision of analgesia as necessary.
4. Educate the patient in the Valsalva maneuver and assist the patient to practice prior to chest tube removal.
5. Remove the chest tube following proper procedure.
6. Conduct a thorough nursing assessment of the patient following chest tube removal.
7. Document the nursing assessments and communicate any concerns or negative outcomes to the physician immediately.

### Chest Tube Removal Procedure

Step	Rationale
<p>Position the patient in the most appropriate position for chest tube removal (supine, a degree of semi-fowler's on the unaffected side). Obtain a linen saver pad.</p> <p>It is important to assess the patient's need for analgesic and to ensure that a physician's order has been written prior to beginning the procedure</p>	<p>This allows for adequate viewing of the chest tube insertion sites and is most comfortable for the patient.</p>
<p>Turn the chest tube suction off, if applicable</p>	<p>If a pleural tube is being removed, ensure that there is no bubbling in the water seal chamber (to ensure that air has been removed from the pleural space).</p> <p><b>If the patient has two chest tubes into the same lung and there is an air leak present, you can still pull one tube as long as the other tube with air leak remains.</b></p> <p><b>Turning the suction off also decreases resistance when removing the chest tube(s).</b></p>

Step	Rationale
Remove the chest tube dressing without exerting tension on the tube(s). Assess the site for signs of infection and collect swab for culture if a discharge is present.	
Prepare occlusive dressing.	The dressing must be occlusive to prevent air from entering the patient's chest via the chest tube insertion site. This prevents a pneumothorax if the pleural space has been entered.
Glove (use clean, non-sterile) and using sterile gauze, cleanse the site with chlorhexidine solution. Allow at least 30 seconds contact time and allow to dry thoroughly.	Drying time is necessary to complete the bactericidal action of the chlorhexidine.
Remove the securing suture. Do not clamp the chest tube unless ordered by physician.	Clamping unnecessarily creates increased intrathoracic pressure.
Instruct the patient to take a deep breath, hold it and bear down slightly (Valsalva Maneuver). You will tell the patient to hold their breath while removing the tube, then to breathe again when you have control of the site.	Practice this with the patient prior to removing the chest tube(s). If the patient is unable to obey commands or is on a ventilator, remove the chest tube(s) at the beginning of exhalation, just at the end of inspiration.
Hold the occlusive dressing lightly over the chest tube insertion site. Use 1-3 adaptic, or 2 jelonet, and 4X4 gauze and secure with hypafix.	
Remove the chest tube(s) in a swift, smooth downward motion. If any resistance is met while removing the chest tube(s), stop the procedure, redress the insertion site with an occlusive dressing and notify the physician.	
Secure the occlusive dressing over the site. The occlusive chest tube dressing may be removed in 24 hours.	
Assess patient and auscultate chest. Monitor vital signs including SpO <sub>2</sub>	Breath sounds should be clear and equal x 4 lung fields.
. Document in the patient chart: <ul style="list-style-type: none"> <li>• the date and time of removal;</li> <li>• the condition of the site;</li> <li>• amount of drainage; and</li> <li>• patient tolerance of the procedure.</li> </ul>	
Report to physician: <ul style="list-style-type: none"> <li>• any resistance met while removing the chest tube;</li> <li>• if the site appears infected; or</li> <li>• any complications arising from chest tube removal.</li> </ul>	Astute nursing assessments can identify clinical indicators of a pneumothorax with or without a CXR. IF the patient clinically shows signs/symptoms of a pneumothorax, the physician should be notified STAT and a portable CXR is required.

## Chest Tube Removal - Complications and Interventions

Problem	Signs / Symptoms	Interventions
<b>Recurrent Pnuemothorax</b>	May hear air entering the pleural space “sucking sound” at insertion site, dyspnea, asymmetric chest movement, sharp chest pain, decreased or absent breath sounds on the affected side	<p>Apply occlusive dressing.            Notify Physician immediately            Obtain STAT portable chest x-ray            Check vitals signs including S<sub>p</sub>O<sub>2</sub> and perform respiratory assessment            Elevate head of bed            Prepare for re-insertion of chest tube</p>
<b>Tension Pneumothorax</b>	Acute chest pain in affected side, tachypnea, severe dyspnea, trachea may be deviated, diminished chest wall expansion on affected side, decreased blood pressure, increased JVP (jugular venous distension), sudden sustained increase in ventilator pressure in a mechanically ventilated patient (high pressure alarm on vent)	<p>Notify Physician Immediately            Obtain 14 gauge angiocath – the physician will insert the angiocath into the chest at the 2<sup>nd</sup> intercostal space mid-clavicular line to relieve the tension and prevent hemodynamic collapse            Note: The angiocath will be left in place temporarily while a chest tube is inserted, or removed and an occlusive dressing applied over the site once air has been released            Arrange STAT portable CXR</p>

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## Appendix A

### Removal of Chest Tube Certification Test ICU RN Only

Read the following and circle the answer you feel best answers the question or best completes the sentence.

1. The physician orders the removal of a chest tube. On assessment you note that there is an air leak present. You should:
  - a. Proceed with removal
  - b. Clamp the chest tube prior to removal
  - c. Report your finding to the physician and confirm chest tube should be removed
  - d. Turn off the wall suction before removing the chest tube
2. A chest tube placed for drainage of fluid from the pleural space is usually placed in which intercostal space?
  - a. Second intercostal space, mid-clavicular line
  - b. Fourth intercostal space, mid-clavicular line
  - c. Fifth intercostal space, mid-axillary line
  - d. Seventh intercostal space, posterior axillary line
3. Which of the following features of pleural drainage systems indicate an active pleural leak?
  - a. Bubbling in the water seal chamber
  - b. Bubbling in the collection chamber
  - c. Fluctuation of the water in the water seal chamber with respirations
  - d. No fluctuation of water in the water seal chamber with respirations
4. If the chest tube insertion site appears infected, do all of the following EXCEPT:
  - a. Swab discharge and send for culture and sensitivity
  - b. Assess patient for signs of systemic infection
  - c. Leave the site open to air
5. Anterior chest tubes for the drainage of air causing a pneumothorax is usually placed in which intercostal space?
  - a. First intercostal space, anterior-clavicular line
  - b. Second intercostal space, mid-clavicular line
  - c. Fourth intercostal space, anterior axillary line
  - d. Sixth intercostal space, mid-axillary line
6. Following chest tube removal, sharp chest pain, dyspnea, a sucking sound through the chest tube insertion site and diminished chest wall expansion on the affected side are signs of:
  - a. Recurrent pneumothorax
  - b. Tension pneumothorax
  - c. Haemothorax
  - d. Pulmonary embolism

- 
7. A 23 year old female admitted 3 days ago following a motor vehicle accident has a fourth and fifth rib fracture. You have just removed her chest tube that she has had for 3 days. Shortly after removal, she develops shortness of breath, deviation of her trachea to the right side, and diminished breath sounds on the left. What condition is likely developing?
- Recurrent pneumothorax
  - Tension pneumothorax
  - Haemothorax
  - Pulmonary embolism
8. Prior to chest tube removal, which of the following interventions are required?
- Confirm physician order, explain procedure to patient, provide analgesic
  - Educate patient about valsalva manoeuvre
  - Apply occlusive dressing
  - Reassess patient including vital signs and respiratory assessment post removal
  - All of the above
  - a and b
  - a, b and c
9. Clamping the chest tube prior to removal is necessary.
- True
  - False
10. What nursing interventions would you take if a patient experienced signs and symptoms of a recurring pneumothorax following removal of the chest tube?
- \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_

Appendix B

COMPETENCY CHECKLIST FOR Removal of Chest Tube ICU RN Only			
	Yes	No	Comment
1. Confirms physician order for removal of chest tube. Ensures x-ray confirmation of resolution of pneumothorax, less than 150 mL drainage in 12 hours and no air leak in past 24 hours. Ensures physician knows most recent INR , platelets, hemoglobin and hematocrit values and that these values are within normal or acceptable range.			
2. Collect appropriate supplies including sterile dressing tray, chlorhexidine solution, scissors to remove sutures, adaptic, 4x4 gauze and hypafix for occlusive dressing.			
3. Wash hands. Apply clean gloves.			
4. Performs 2 patient identifier process.			
5. Explains the procedure to the patient.			
6. Teaches patient Valsalva manouever and practices breath holding with patient.			
7. Positions patient to expose the chest tube insertion site			
8. Turns wall suction off, if applicable.			
9. Using sterile technique for dressing tray, cleanse chest tube insertion site with chlorhexidine and allows to dry.			
10. Holding chest tube, cuts and removes suture.			
11. Loosely holds dressing over insertion site. Instructs patient to take a deep breath, hold it and bear down (the Valsalva Manouever).			
12. While holding the dressing in place, remove the chest tube with swift, smooth downward pulling motion while patient is holding breath or if mechanically ventilated, at the end of inspiration (and during exhalation).			
13. Secure occlusive dressing over site.			
14. Assesses patient and auscultates chest. Indicates presence of normal breath sounds.			
15. Remove and discard gloves. Perform hand hygiene.			
Document: <ul style="list-style-type: none"> <li>• Date and Time of Removal</li> <li>• Insertion site appearance</li> <li>• Amount and color of drainage</li> <li>• Any complications and patient tolerance of procedure</li> <li>• Vital signs, SpO<sub>2</sub> and respiratory assessment</li> </ul>			

Date: _____	Time: _____	Nurse Preceptor: _____
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Date: _____	Time: _____	Nurse Preceptor: _____
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On Completion Present this Form to Your Manager