1. INTRODUCTION

Bronchial Hygiene and Lung Expansion Therapy (BH-LET) is composed of varieties of modalities which facilitates airway clearance and promotes lung expansion. This document will promote standard patient care while facilitating effective communication among health care providers at respected PSMMC.

2. PURPOSE

To provide standardized guidelines to perform safe and effective chest physiotherapy.

3. RESPONSIBILITIES

All sections of this Policy applies to RCD Staff

4. DEFINITION

4.1 **BH-LET:** Bronchial Hygiene & Lung Expansion Therapy
4.2 **PD:** Postural Drainage
4.3 **RCP:** Respiratory Care Practitioner
4.4 **PDP:** Postural Drainage Protocol
4.5 **ICP:** Intra Cranial Pressure
4.6 **PAP:** Positive Airway Pressure
4.7 **CPAP:** Continuous Positive Airway Pressure
4.8 **ICS:** Intensive Care Services
4.9 **PFT:** Pulmonary Function Test
4.10 **ABG:** Arterial Blood Gas
4.11 **IS:** Incentive Spirometry
4.12 **PV/PD:** Percussion Vibration/ Postural Drainage
4.13 **IPPB:** Intermittent Positive Pressure Breathing
4.14 **HFCO:** High Frequency Compression/Oscillation
4.15 **M & E:** Mobilization & Exercise
4.16 **DC:** Direct Cough
4.17 **NIPPV:** Non Invasive Positive Pressure Ventilation
4.18 **CXR:** Chest X-Ray
4.19 **CPT:** Chest Physical Therapy
4.20 **WOB:** Work of Breathing
4.21 **MH:** Manual Hyperinflation

5. POLICY

5.1 Order is initiated by the physician of PSMMC after thorough assessment and meeting the inclusion criteria for the treatment.

5.2 The written order and frequency of treatment and for how many days the treatment will be given must be documented in patient's file by the physician, which is agreed mutually with assigned RCP/ or RCP team leader/RCP charge/RCP supervisor.

5.3 The frequency of BH-LET

5.3.1 Cannot be ordered at the frequency of less than Q6 hourly. (i.e. Q4 hourly) in Non-acute clinical areas.

5.3.2 The service of BH-LET is offered to patients of PSMMC 24/7 & 7 days a week,

5.4 The BH-LET order is valid for duration of **three days** and can be renewed as needed; i.e.

5.4.1 Patient clinically NOT stable, and requires BH-LET as per physical assessment of Physician/ or RCP.

5.4.2 Recent CXR within **(24-48 hrs)**, shows the indication of BH-LET.

5.5 Patients who require BH-LET at a frequency of 2 hourly or more must be evaluated for critical monitoring & care in ICU by Critical Care physician.

5.6 Automatic stop order would be applied, if meets all of the following conditions; i.e.

5.6.1 Patient is clinically stable, doesn't require BH-LET as per the physical assessment of RCP and communicated with physician.

5.7 In the event the RCP received a questionable order for BH-LET, the physician will be notified and clarification or complete order must be obtained.

5.8 Upon receipt of an order for BH-LET, the RCP shall communicate with prescribing physician and choose the appropriate modality of the therapy to be rendered to the patient, depending upon:

5.8.1 Chart Review.

5.8.2 Interview of the patient.

5.8.3 Physical assessment (Patient's: WOB, Alertness, Cooperation, Understanding).

5.8.4 Laboratory results: Including Pulmonary Function Test (if available).

5.8.5 Radiological evaluation (CXR within 24-48 hrs)

5.9 BH-LET shall include, one, some or all of the following modalities:

5.9.1 *Incentive Spirometry*

5.9.2 *Postural Drainage Therapy*

5.9.2.1 Turning
5.9.2.2 Postural Drainage
5.9.2.3 Percussion and Vibration

5.9.3 *Coughing and Related Expulsion Techniques*

5.9.3.1 Directed Cough
5.9.3.2 Forced Expiratory Technique
5.9.3.3 Active Cycle of Breathing
5.9.3.4 Autogenic Drainage
5.9.3.5 MIE

5.9.4 *Positive Airway Pressure Adjuncts*

5.9.4.1 Positive Airway Pressure
5.9.4.2 CPAP
5.9.4.3 EPAP
5.9.4.4 PEP/Acupella/Flutter Valve

5.9.5 *IPPB and IPV*

5.9.6 *High Frequency Compression/Oscillation (Vest)*

5.9.7 *Mobilization and Exercise*

5.10 Prior to Postural Drainage Therapy, feeding must be stopped at least 1 hour prior to therapy.

5.11 During Non-Office hours i.e. during weekends/night shifts, for any new referral or request for BH-LET, the RCP must communicate with his or her charge/supervisor to review and approval.

5.12 BH-LET order must be re-ordered if patient is transferred to different Unit or other clinical area.

5.13 Factors in Selecting an modality:

5.13.1 Chose modality that is safest, simplest, & most effective.

5.13.2 RT should evaluate the following before choosing a specific modality:

5.13.2.1 Level of patient cooperation
5.13.2.2 Amount of pulmonary secretions
5.13.2.3 Patient's spontaneous vital capacity

5.14 Factors in selecting a Bronchial Hygiene Strategy:

5.14.1 Patient's Motivation
5.14.2 Patient's goals
5.14.3 Physician/RCP goals
5.14.4 Effectiveness of technique
5.14.5 Patient's age
5.14.6 Patient's ability to concentrate
5.14.7 Ease of learning and teaching
5.14.8 Skill of therapists
5.14.9 Need of assistants or equipment
5.14.10 Limitations of technique based on disease type and severity
5.14.11 Costs (direct & indirect)
5.14.12 Desirability of combining methods

6. PROCEDURES

6.1 Written order is required from ordering physician in the CERNER.

6.2 RCP verifies physician order and obtains clarification if needed.

6.3 Properly identify and confirm the patient as per the PSMMC patient identification policy.

6.4 Review patient's medical history.

6.5 Check the patient's chart and review the followings:

6.5.1 ABG

6.5.2 Chest X-RAY.

6.5.3 Admitting diagnosis and history.

6.5.4 Laboratory and microbiology results.

6.5.5 Look for any contraindications for the procedure in the chart

6.6 Initial application of the BH-LET system:

6.6.1 The physician and/or RCP shall explain use of the BH-LET to associated health care staff.

6.6.2 The physician and/or RCP shall explain the procedure to the patient, prior to starting.

6.7 The patient should be cooperative and able to understand and follow basic instructions.

6.8 Assess the patient's CXR for pulmonary findings and assess the indications for BH-LET.

6.9 Wash hands and using appropriate PPE's as per Infection control approved policy.

6.10 Enter patient's room; introduce yourself to the patient and the purpose of the visit.

6.11 Prior implementing BH-LET, perform a physical assessment, not limiting to: Respiratory rate, work of breathing, heart rate and rhythm, skin color, blood pressure, pulse oximetry and breath sounds.

6.12 Interview the patient if having an effective cough and the ability to mobilize secretions, and breathing difficulty (i.e. ability to take a deep breath or the existence of exertion dyspnea).

6.13 Choose the appropriate modality according to bronchial hygiene strategy and recommende airway clearance techniques.

6.14 Gather and assemble appropriate equipment's according to the chosen modality.

6.15 Familiarize the patient with equipment and explain the expectation of therapy.

6.16 Educate/instruct the patient on indications, complications and importance of performing BH-LET.

6.16.1 General Indications:

6.16.1.1 Excessive sputum production
6.16.1.2 Reduced effectiveness of cough
6.16.1.3 History of success in treating a pulmonary problem with CPT
6.16.1.4 Adventitious breath sounds are suggestive of secretions in the airways, which persists after coughing.
6.16.1.5 Abnormal CXR, suggesting atelectasis, mucus plugging.

6.16.2 General Contraindications:

6.16.2.1 Acute pulmonary embolus
6.16.2.2 Severe Hemoptysis
6.16.2.3 Large Empyema
6.16.2.4 Untreated Pneumothorax
6.16.2.5 Untreated pleural effusion
6.16.2.6 Un-stabilized head and/neck injury
6.16.2.7 Active hemorrhage with hemodynamic instability.
6.16.2.8 Active spinal injury
6.16.2.9 Active hematemesis
6.16.2.10 Broncho-pleural fistula
6.16.2.11 Cardiogenic pulmonary edema
6.16.2.12 Flail Chest
6.16.2.13 Confused, anxious, or otherwise impaired patients who actively resist or do not tolerate position changes (E.g. Orthostatic hypotension)
6.16.2.14 Temporary pacemaker
6.16.2.15 Percussion over fractured ribs
6.16.2.16 Recent spinal surgery (i.e. laminectomy)

6.17 **Postural Drainage/Positioning:**

6.17.1 Feeding should be stopped **ONE** hour prior the postural drainage therapy.

6.17.2 Place the patient with the segmental bronchus to be drained in a vertical position relative to gravity as per the Appendix- 'A'

6.17.3 Ensure patient's comfort, proper support of all joints, bony areas with pillows/towels.

6.17.4 The position is held for 3 to 15 minutes, depending upon the outcome in regards to sputum production, considering the patient is able to tolerate the therapy with acceptable vital signs.

6.17.5 For maximum effect, head down position should exceed 25 degree below horizontal, exception to those who are not indicted for such position, due to related contraindication.

6.17.6 Ensure appropriate coughing technique is applied, both during and after positioning.

6.17.7 Avoid strenuous coughing when using head-down position, as this will markedly increase ICP.

6.17.8 Reposition as necessary so that the patient is relaxed between the positions and breathing is controlled to prevent hypoxemia.

6.17.9 FiO_2 may be increase during positioning as indicated.

6.17.10 Treatment time should not exceed more than **30** minutes.

6.17.11 **Turning**

6.17.11.1 Indications:

6.17.11.1.1 Inability or reluctance of the patient to change body position.

6.17.11.1.2 Poor oxygenation associated with position i.e. unilateral lung disease.

6.17.11.1.3 Potential or actual atelectasis.

6.17.11.1.4 Presence of artificial airway.

6.17.11.1.5 Lung expansion, improve oxygenation and prevent retention of secretions.

6.17.11.2 Contraindications:

6.17.11.2.1 Unstable spinal cord injuries

6.17.11.2.2 Severe diarrhea

6.17.11.2.3 Marked agitation

6.17.11.2.4 Increase in ICP

6.17.11.2.5 Drop in blood pressure (>10%)

6.17.11.2.6 Worsening in dyspnea

6.17.11.2.7 Hypoxia

6.17.11.2.8 Cardiac arrhythmias

6.17.2 **Postural Drainage:**

6.17.2.1 **Indications:**

6.17.12.1.1 Evidence or suggestion of difficulty with secretion clearance.

6.17.12.1.2 Adult patient having difficulty expectorating sputum volume greater than 25 ml/day.

6.17.12.1.3 Evidence or suggestion of retained secretions in a patient with an artificial airway.

6.17.12.1.4 Presence of atelectasis caused by or suspected of being caused by mucus plugging.

6.17.12.1.5 Diagnosis of a disease with altered radiology such as Cystic fibrosis, Bronchiectasis, and or cavitary lung disease.

6.17.12.1.6 Patients with neurological abnormalities (spasticity, bulbar palsy and aspiration prone).

6.17.12.1.7 Presence of a foreign body in the airway

6.17.12.1 Contraindications:

6.17.12.2.1 Head and neck injury until stabilized

6.17.12.2.2 Active hemorrhage with hemodynamic instability

6.17.12.2.3 High ICP.

6.17.12.2.4 Active Hemoptysis

6.17.12.2.5 Empyema

6.17.12.2.6 Broncho-pleural Fistula

6.17.12.2.7 Pulmonary Edema associated with CHF

6.17.12.2.8 Aged, confused or anxious patients who do not tolerate position changes.

6.17.12.2.9 Pulmonary embolism

6.17.12.2.10 Surgical wound or healing tissue

6.17.12.2.11 Large pleural effusions

6.17.12.2.12 Uncontrolled hypertension

6.17.12.2.13 Distended abdomen

6.17.12.2.14 Uncontrolled airway at risk for aspiration (Tube feeding or meal within one (1) hour)

6.17.12.2.15 Recent esophageal surgery

6.18 **Percussion/Vibration:**

6.18.1 For postural drainage, apply article 6.17.12 of this policy. Ensure there is a thin barrier between the precursor and the patient's skin (such as Cloths, gown, etc.)

6.18.2 Assure the following when using Mechanical Vibrator:

6.18.2.1 Set the vibrator to a low frequency.

6.18.2.2 Hold the handle of the hand assembly in one hand and the other hand on the patient as a guide for the area to be vibrated.

6.18.2.3 Place vibrator against chest wall above the intended bronchial segment for approximately one minute while patient breathes normally.

6.18.2.4 The pressure applied to the chest wall with mechanical vibrator is most important and is determined by tolerance and condition of the patient.

6.18.2.5 Use a hand pressure or force which is not discomforting to the patient.

6.18.2.6 With the patient in a reclined position, the weight of the mechanical head assembly alone may be enough pressure to be effective.

6.18.2.7 Increase the frequency setting, and instruct the patient to cough through the procedure.

6.18.2.8 The RCP should select high/low frequency settings that produces most effective lung resonance for each patient, according to patient's tolerance.

6.18.3 Assure the followings when using Manual Precursor

6.18.3.1 Place cupped shaped hand on the affected area and the other hand on the patient as a guide on the area to be percussed.

6.18.3.2 Apply percussion over the lobe or segment that need to be drained.

6.18.3.3 Instruct the patient to cough through the procedure.

6.18.4 Percuss in a circular pattern over localized area for a period of 3-5 minutes.

6.18.5 Reposition the patient properly if indicated.

6.18.6 **Indications:**

6.18.6.1 Percussion and vibration are done to increase the volume of sputum production in some patients where postural drainage alone fails to mobilize secretions.

6.18.6.2 Sputum volume or consistency suggesting a need for additional manipulation (percussion and/or vibration) to assist movement of sputum in a patient receiving postural drainage.

6.18.6.3 Patients with cystic fibrosis, ciliary dyskinesia and bronchiectasis

6.18.6.4 Atelectasis

6.18.6.5 Asthma (with mucus plugging)

6.18.6.6 Patients with neurological abnormalities (spasticity, bulbar palsy and aspiration prone).

6.18.7 Contraindications:

6.18.7.1 Subcutaneous emphysema
6.18.7.2 Recently placed trans-venous pacemaker or subcutaneous pacemaker.
6.18.7.3 Lung contusion
6.18.7.4 Osteomyelitis of the ribs
6.18.7.5 Coagulopathy
6.18.7.6 Recent skin graft or flaps on the thorax
6.18.7.7 Suspected pulmonary tuberculosis
6.18.7.8 Bronchospasm
6.18.7.9 Osteoporosis
6.18.7.10 Complaint of chest wall pain

6.19 **Directed Cough**

6.19.1 Have the patient on the sitting position with shoulders rotated inward, head and spine slightly downward.

6.19.2 Provide support for the feet.

6.19.3 Instruct the patient to breathe slowly and deeply through the nose using the diaphragmatic method (only to moderate depth in COPD).

6.19.3.1 Patient should place one hand on his abdomen and the other on his/her upper chest.

6.19.3.2 Patient should inhale slowly and deeply through his/her nose, while breathing in, patient should push his stomach out. The hand on the

abdominal muscles should move upward, and the hand on the upper chest should not move.

6.19.3.3 Patients should exhale slowly through pursed lips or normally through his/her mouth while tighten his/her abdominal muscles. At the same time, patient should use their hand to gently push his/her abdomen inward and upward. Again, the chest should NOT move.

6.19.4 Confirm good/deep inspiration.

6.19.5 Have patient close down glottis, same manner as occurs while straining during stools.

6.19.6 Enhance expulsion by having the patient exhale with moderate force through pursed lips while bending forward.

6.19.7 Be aware that 3 to 4 repetitions are recommended.

6.19.8 Ask patient to stage his/her expiratory effort into 2 or 3 short bursts (Huff cough).

6.19.9 **Indications:**

6.19.9.1 The need to aid in the removal of retained secretions from central airways.

6.19.9.2 Presence of atelectasis.

6.19.9.3 As prophylaxis against post-operative pulmonary complications.

6.19.9.4 As a routine part of bronchial hygiene in patients with cystic fibrosis, bronchiectasis, chronic bronchiolitis, necrotizing pulmonary infection or spinal cord injury.

6.19.9.5 As an integral part of other bronchial hygiene therapies/strategies.

6.19.9.6 To obtain sputum specimens for diagnostic analysis.

6.19.10 Contraindications:

6.19.10.1 Obtunded, paralyzed or uncooperative patients.

6.19.10.2 Patients with advanced COPD or severe restrictive disorders (including neurological, muscular or skeletal abnormalities), who may not be able to generate an effective spontaneous cough.

6.19.10.3 Inability to control possible transmission of infection from patients suspected or known to have pathogens transmittable by droplet nuclei (e.g. Mycobacterium Tuberculosis).

6.19.10.4 Presence of an elevated ICP or known intracranial aneurysm.

6.19.10.5 Presence or reduced coronary artery perfusion, such as in acute myocardial infarction.

6.19.10.6 Acute unstable head, neck or spinal injury.

6.19.10.7 Manually assisted directed cough with pressure to the epigastrium may be contraindicated in presence of increased potential for regurgitation/aspiration, acute abdominal pathology, abdominal aortic aneurysm, hiatal hernia, pregnancy, a bleeding diathesis or untreated pneumothorax.

6.19.10.8 Manually assisted directed cough with pressure to the thoracic cage may be contraindicated in presence of osteoporosis of flail chest.

6.20 Deep Coughing

6.20.1 Patient should be sitting on a chair or on the bed edge, with both feet on the floor, leaning slightly forward in relaxed state.

6.20.2 Have your patient oxygenating himself or herself with 2 or 3 pursed lip breaths.

6.20.3 Have your patient folds his or her abdomen, takes a breath that is slightly deeper than normal through nose using the diaphragm and hold his or her breath for 2-3 seconds.

6.20.4 The lean forward, pressing your arms against your abdomen using his or her stomach muscles to cough forcefully 2-3 times through a slightly open mouth. Coughs should be short and sharp. Ask patient to avoid a hacking cough or merely clearing the throat. A deep cough is less tiring and more effective in clearing mucus out of lungs.

6.20.5 Breathe in again by 'sniffing' slowly and gently through your nose. This gentle breath helps prevent mucus from moving back down your airways.

6.20.6 Rest the patient.

6.20.7 Perform again if needed.

6.21 **Forced expiratory Technique/Huff Coughing**

6.21.1 Patient should be sitting on a chair or on the bed edge, with both feet on the floor, leaning slightly forward in relaxed state.

6.21.2 Have your patient oxygenating himself or herself with 2 or 3 pursed lip breaths.

6.21.3 Then ask him or her to take a breath that is slightly deeper than normal through the nose using his diaphragm and hold his or her breath for 2-3 seconds.

6.21.4 Ask him or her to use stomach muscles to make a series of 3 rapid exhalations (huff) with the airway open, making a "ha, ha, ha" sound.

6.21.5 Ask the patient to repeat the huff coughing technique until the mucus has reached the back of your throat.

6.21.6 Educate your patient that once the mucus has reached the back of your throat, perform deep cough to expel it.

6.21.7 **Indications:**

6.21.7.1 It is better for sputum production and clearance than directed coughing especially when combined with postural drainage.

6.21.7.2 Patients prone to airway collapse during normal coughing such as those with emphysema, CF or bronchiectasis.

6.21.8 **Contraindications:**

6.21.8.1 Patients unable to generate high expiratory airflow (e.g. intubated patients with respiratory failure).

6.22 **Active Cycle of Breathing/ Modified Forced Expiratory Technique**

6.22.1 Assure that it is performed in the sitting position, although it is considered most beneficial when combined with postural drainage therapy.

6.22.2 Have the patient in relaxed state, and then perform gentle diaphragmatic breathing at normal tidal volumes with the relaxation of the upper chest and shoulders.

6.22.3 Perform 3 to 4 thoracic expansion exercises, which involve deep inhalation with relaxed exhalation. This may be accompanied by percussion, vibration or compression.

6.22.4 Repeat the previous procedures.

6.22.5 Perform 1 or 2 FET's of huff coughing.

6.22.6 Repeat procedure as mentioned above in article 6.21.3.

6.22.7 **Indications:**

6.21.8.1 Patients more than 3 years with Cystic Fibrosis, Ciliary Dyskinesia and Bronchiectasis.

6.21.8.2 Atelectasis

6.23 Autogenic Drainage/A modification of Directed Coughing

6.23.1 Have the patient in a sitting position for maximum benefit.

6.23.2 Through diaphragmatic breathing, ask the patient to breathe to full inspiratory capacity followed by exhalation to baseline.

6.23.3 Ask the patient to breathe at low lung volumes for 3 to 5 breaths.

6.23.4 Phase 2: Ask the patient to breathe at low to middle volumes for 3 to 5 breaths.

6.23.5 **Indications:**

Patients more than 12 years with Cystic Fibrosis, Ciliary Dyskinesia and Bronchiectasis.

6.24 ***High Frequency Compression/Oscillation (Vest- Jacket wrapped around patient's Chest)***

6.24.1 Identify the patient and assess the patient for need of treatment.

6.24.2 Follow appropriate infection control guidelines.

6.24.3 Follow appropriate infection control guidelines.

6.24.4 Place the appropriate size Vest (Jacket) around the patient (bladder section of vest in the front of patient), connect the (large corrugated) tubing to the Vest.

6.24.5 Start with minimal settings (Initial settings)

6.24.5.1 Hz 10-12-14
6.24.5.2 Amplitude (Pressure) 8.0
6.24.5.3 Time of Treatment = 5-10 minutes

6.24.6 As patient tolerates, increase the Hz and Amplitude, while assessing and monitoring the patient vital signs.

6.24.7 Monitor closely at bedside; do not leave the patient, while treatment is being delivered.

6.24.8 Discontinue treatment anytime patient complaints, or has any adverse effects.

6.24.9 Single patient use or disposable supplies need to be used for Single patient only, NOT in between the patients.

6.24.10 After the completion of treatment, assess the patient vital signs and response to the treatment.

6.24.11 After the completion of treatment, clean the reusable equipment (Vest machine) as per infection control guidelines.

6.24.12 Document the patient response and the outcome of the treatment (i.e. type and amount of secretions, breath sounds, change of vital signs etc.)

6.25 Modify techniques of BH-LET according to patient tolerance, assist with sputum clearance as needed.

6.26 Ensure patient comfort and safety prior leaving bedside.

6.27 **Documentation must include the following:**

6.27.1 Date and time
6.27.2 Type of Therapy
6.27.3 Frequency (how often being performed)
6.27.4 Respiratory rate, before and after treatment
6.27.5 Heart rate, pre and post treatment
6.27.6 Saturation, before and after
6.27.7 Breath sounds, before and after.
6.27.8 Location/Unit
6.27.9 Areas of concentration (i.e. Lobe/Segment/Sub-Segment of lung)
6.27.10 Position of the patient
6.27.11 Cough effect
6.27.12 Sputum results
6.27.13 Sputum consistency
6.27.14 Sputum color
6.27.15 Sputum production
6.27.16 Complications and interventions
6.27.17 RCP initials

6.28 **MH:** Manual Hyperinflation Therapy (**AKA** Ambu Lavage)

6.28.1 Manual hyperinflation (MH), a frequently applied maneuver in critically ill intubated and mechanically ventilated patients, is suggested to mimic a cough so that airway secretions are mobilized toward the larger airways, where they can easily be removed. As such, MH could prevent plugging of the airways.

6.28.2 Use appropriate pressure similar as patient receiving through mechanical ventilator.

6.28.3 Perform clinical assessment of the patient pre and post procedure.

7. REFERENCES

7.1 Article: Benefits and risks of manual hyperinflation in intubated and mechanically ventilated intensive care unit patients: a systematic review (Critical Care. 2012; 16(4): R145 Published online 2012 Aug 3rd. (10.1186/cc11457) Frederique Paulus,[1] Jan M Binnekade,[1] Margreeth B Vroom,[1] and Marcus J Schultz[1,2]

7.2 Egan's Fundamental of Respiratory Care, Edition 10th, 2013.

8. APPENDICES

8.1 Appendix 1: "BH-LET: Definitions/Abbreviations, Indications and Contraindications"

8.2 Appendix 2: "BH-LET: Complications, Precautions and Adverse Reactions"

8.3 Appendix 3: "Common clinical signs, indicator and treatment"

9. ORIGINATING DEPARTMENT/S

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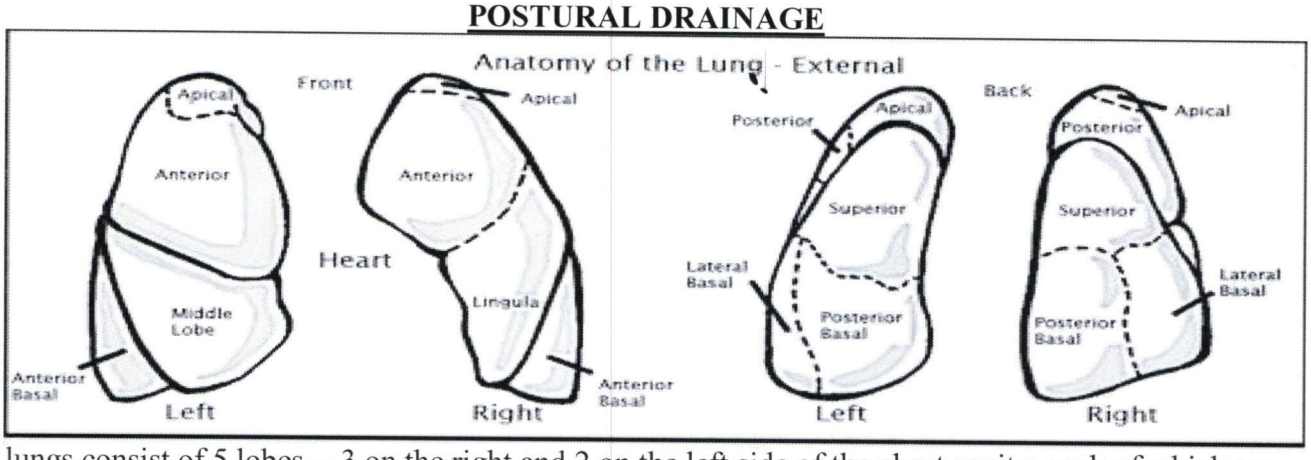
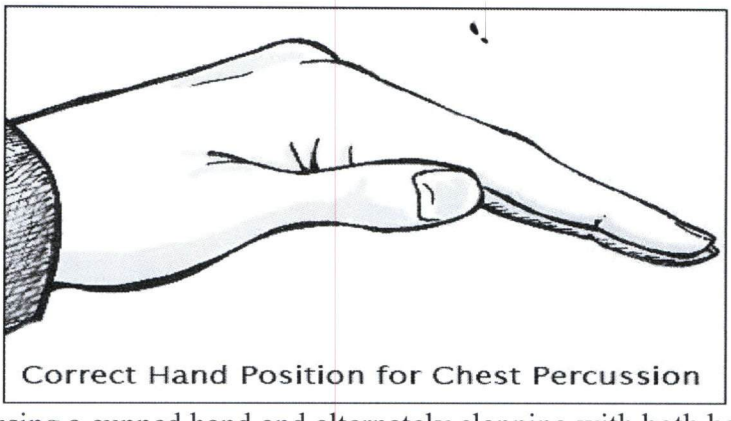
Approved by: **Maj. Gen. Khalid Abdullah Al Hadaithi** **General Executive Director of Prince Sultan Military Medical City**	**Signature:**	**Date:** 21.5.2023

Appendix 1

POSTURAL DRAINAGE

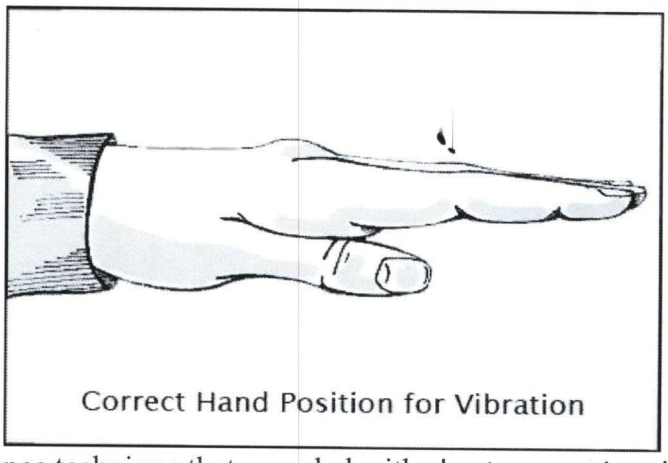


The lungs consist of 5 lobes -- 3 on the right and 2 on the left side of the chest cavity, each of which are further divided into segments. The goal of postural drainage and chest percussion is to help drain mucus from each of these lobes into the larger airways of the lungs so it can be coughed up more readily.
It is important to note that some postural drainage positions may cause an increase of heartburn and acid reflux and/or vomiting, particularly those positions where the head is lower than the stomach. Not only can this cause discomfort and possible wheezing, but vomiting may lead to a lung infection which may cause further lung damage. If you experience these symptoms during postural drainage, talk to your doctor about alternative methods of clearing your airways.



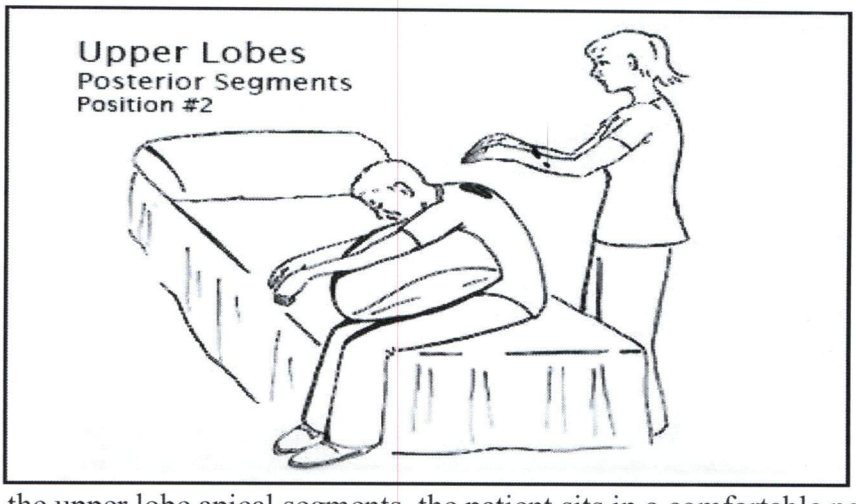
Correct Hand Position for Chest Percussion

Chest percussion involves using a cupped hand and alternately clapping with both hands on the patient's chest wall. This should be performed over the lung segment that is to be drained. Your hand should be NOT be flat, but cupped at all times, as if you were holding liquid in it.
The percussion technique should be vigorous and rhythmical, but it should not involve pain. If the patient does complain of pain, this means that your hand may not be cupped properly and needs to be softened or readjusted. When done properly, you should hear a hollow sound with each percussion.
Chest percussion should be done over the ribs, with careful attention to avoiding percussing over the spine, breastbone, or lower back to prevent damage to internal organs. Percussion may, or may not, be accompanied by vibration.
Mechanical percussors are also available as an alternative to manual chest percussion.

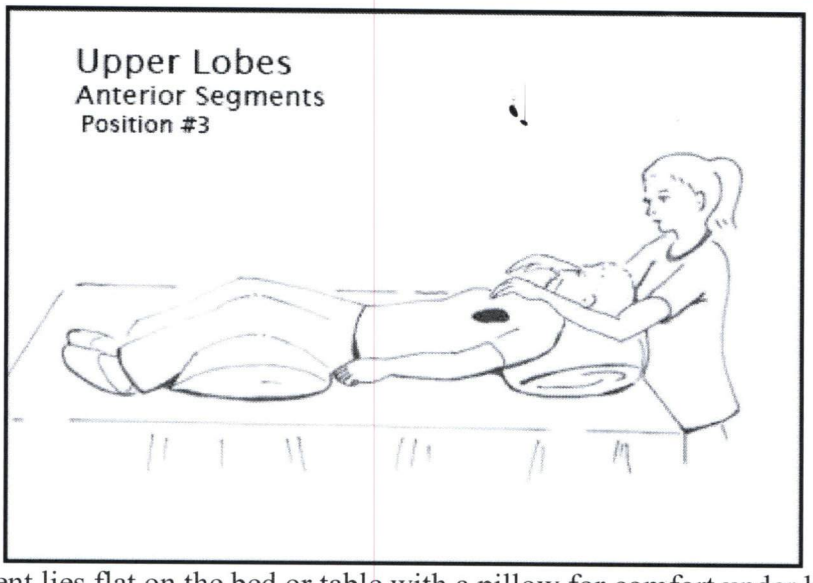


Correct Hand Position for Vibration

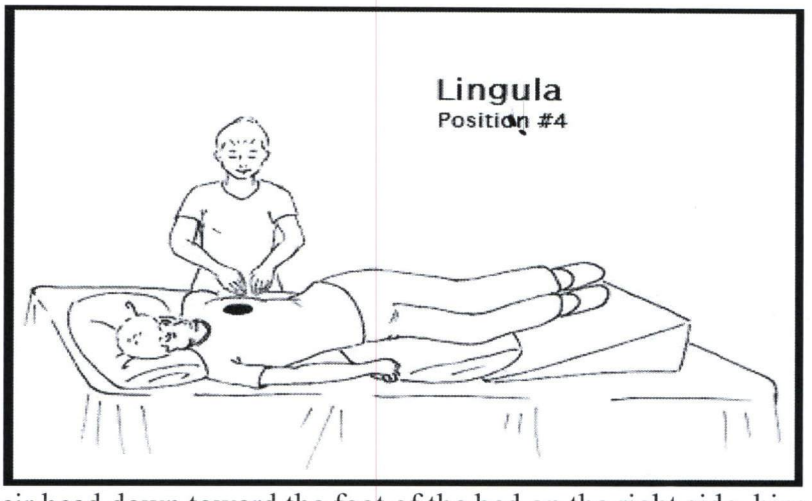
Vibration is an airway clearance technique that, coupled with chest percussion, is applied during postural drainage to help COPD patients clear mucus from the airways. Vibration helps to gently shake mucus and secretions into the large airways, making them easier to cough up.
During vibration, place your flat hand firmly against the chest wall, atop the appropriate lung segment to be drained. Stiffen your arm and shoulder, apply light pressure and create a shaking movement, similar to that of a vibrator.



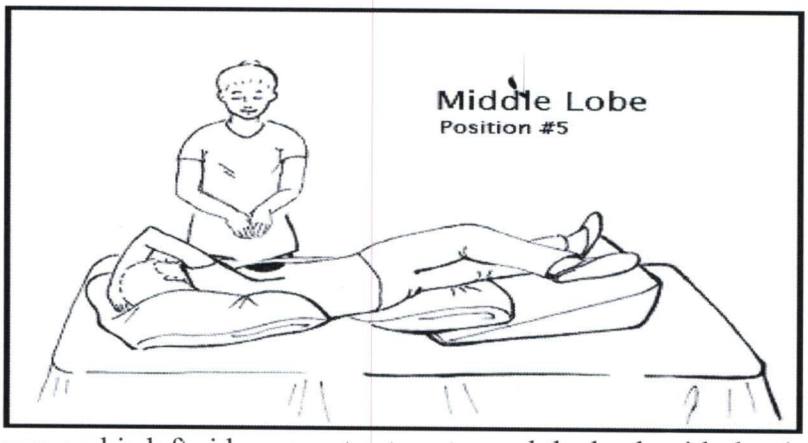
To drain mucus from the upper lobe apical segments, the patient sits in a comfortable position on a bed or flat surface and leans on a pillow against the headboard of the bed or the RCP. The RCP percusses and vibrates over the muscular area between the collar bone and very top of the shoulder blades (shaded areas of the diagram) on both sides for 3 to 5 minutes. Encourage the patient to take a deep breath and cough during percussion in order to help clear the airways. Do not percuss over bare skin.
The patient sits comfortably in a chair or the side of the bed and leans over, arms dangling, against a pillow. The RCP percusses and vibrates with both hands over upper back on both the right and left sides.



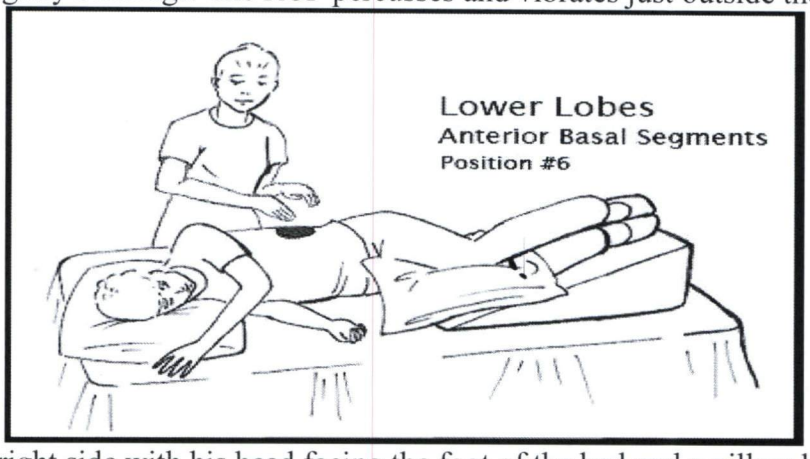
In position #3, the patient lies flat on the bed or table with a pillow for comfort under his or her head and legs. The RCP percusses and vibrates the right and left sides of the front of the chest, between the collar bone and nipple.



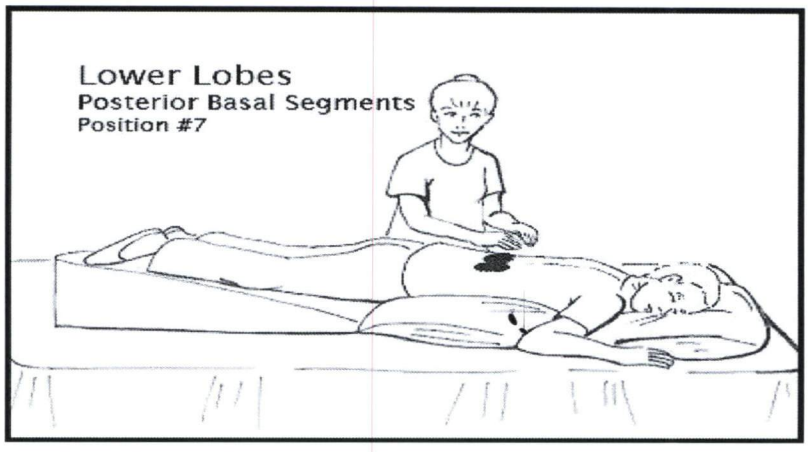
The patient lies with their head down toward the foot of the bed on the right side, hips and legs up on pillows. The body should be rotated about a quarter-turn towards the back. A pillow can also be placed behind the patient and their legs slightly bent with another pillow between the knees. The RCP percusses and vibrates just outside the nipple area.



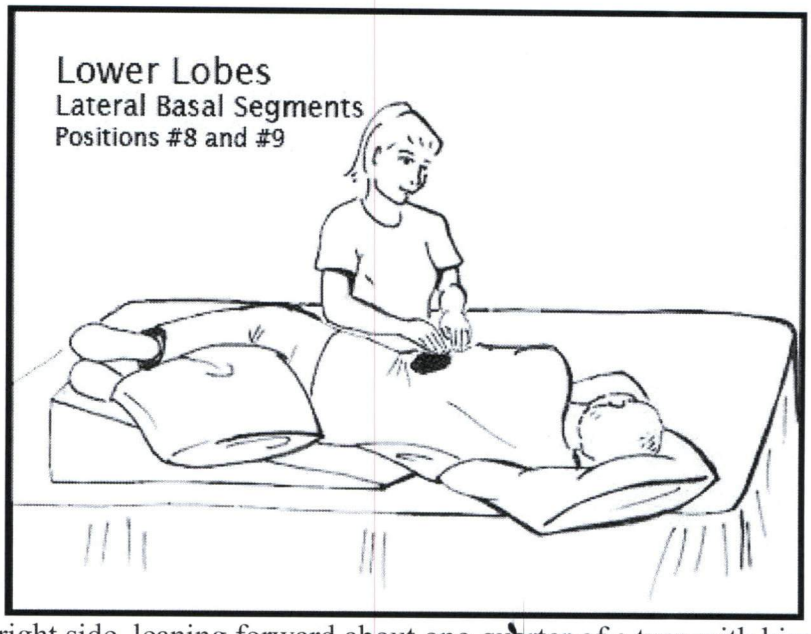
The patient lies head-down on his left side, a quarter-turn toward the back with the right arm up and out of the way. The legs and hips should be elevated as high as possible. A pillow may be placed in back of the patient and between slightly bent legs. The RCP percusses and vibrates just outside the right nipple area.



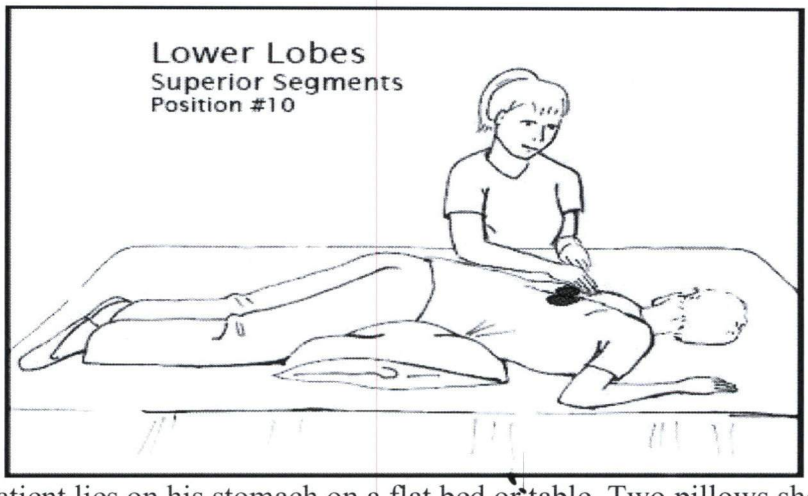
The patient lies on his right side with his head facing the foot of the bed and a pillow behind his back. The hips and legs should be elevated as high as possible on pillows. The knees should be slightly bent and a pillow should be placed between them for comfort.
The RCP percusses and vibrates over the lower ribs on the left side, as shown in the shaded part of the diagram. This should then be repeated on the opposite side, with percussion and vibration over the lower ribs on the right side of the chest.



The patients lies on his or her stomach, with the hips and legs elevated by pillows. The RCP percusses and vibrates at the lower part of the back, over the left and right sides of the spine, careful to avoid the spine and lower ribs.



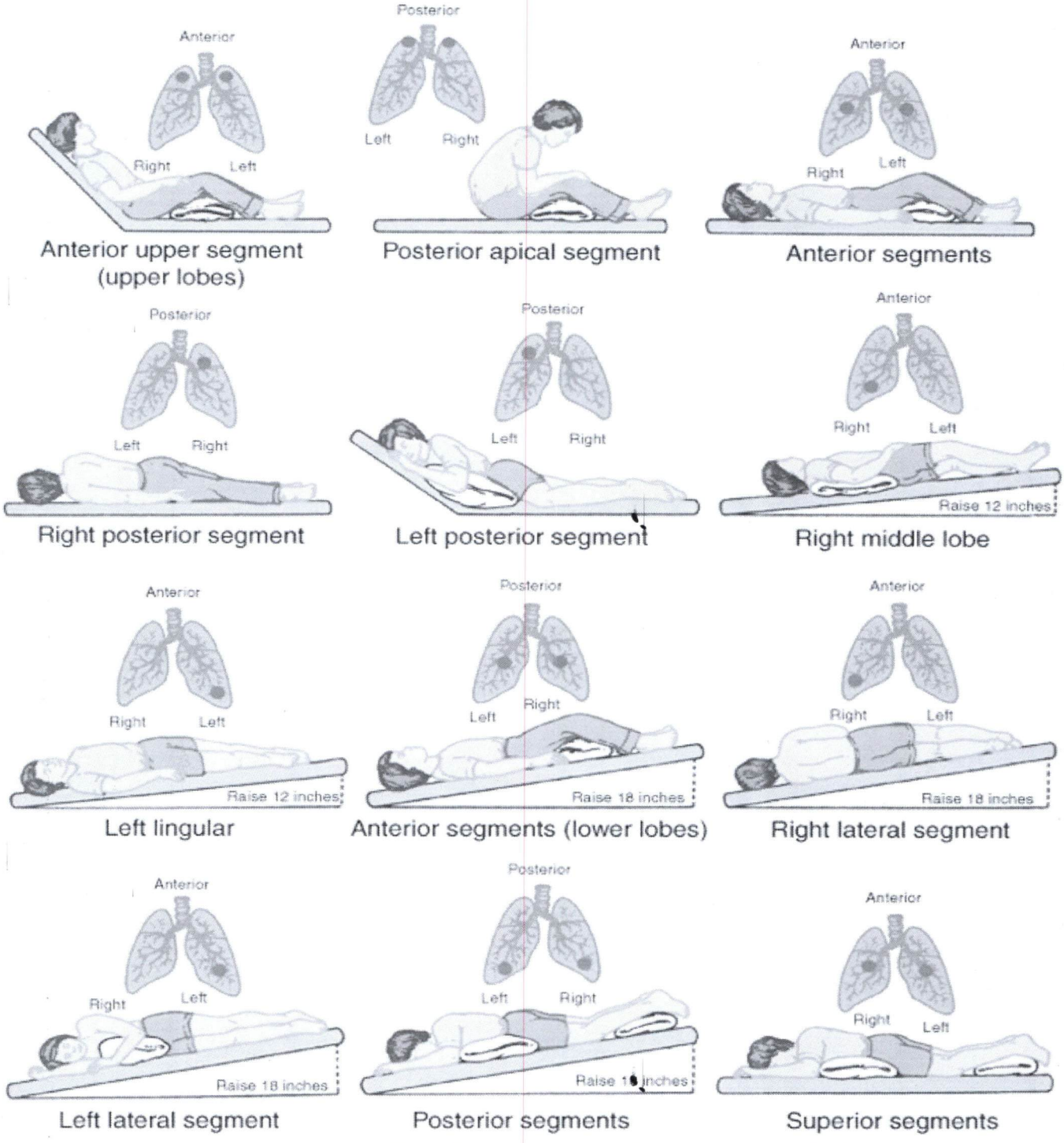
The patient lies on his right side, leaning forward about one-quarter of a turn with hips and legs elevated on pillows. The top leg may be flexed over a pillow for support and comfort. The RCP percusses and vibrates over the uppermost portion of the lower part of the left ribs, as shown in the shaded area. This should then be repeated on the opposite side, with percussion and vibration over the uppermost portion of the right side of the lower ribs.



For this position, the patient lies on his stomach on a flat bed or table. Two pillows should be placed under the hips.

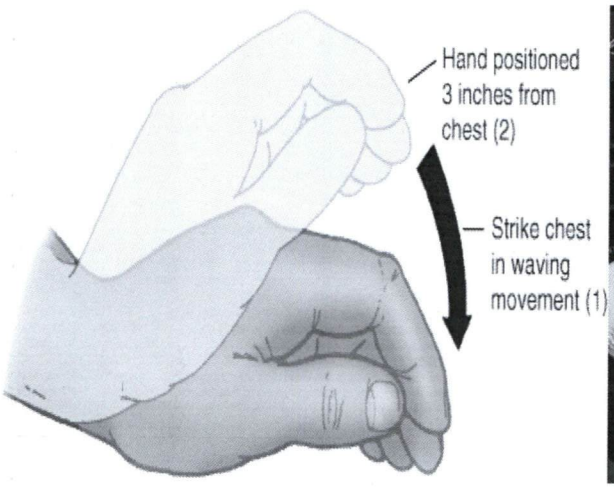
The RCP percusses and vibrates over the bottom part of the shoulder blades, on both the right and left sides of the spine, avoiding direct percussion or vibration over the spine itself.

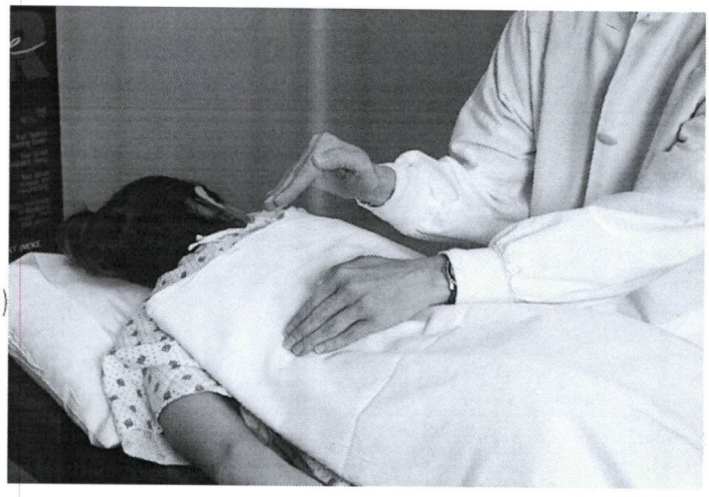
Airway Clearance Methods

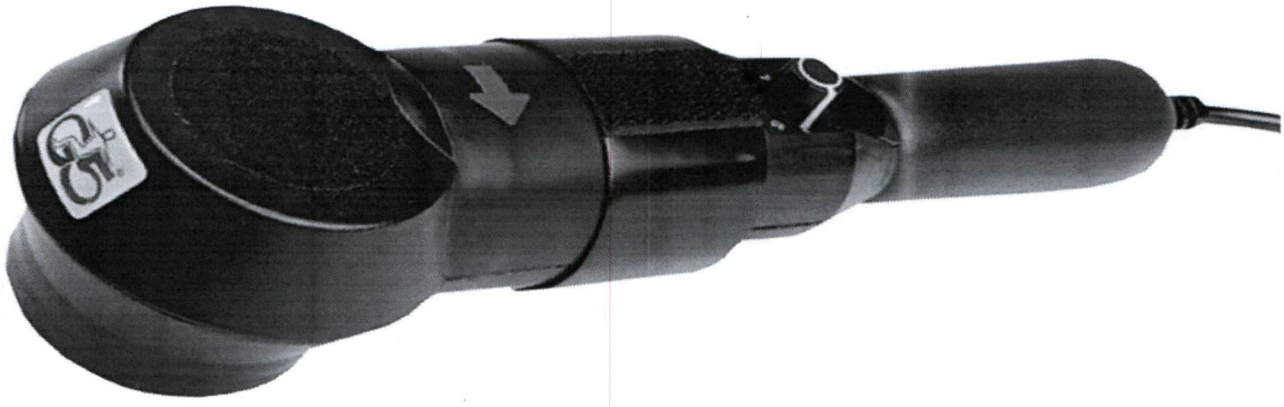


(Modified from Potter PA, Perry AG: Fundamentals of nursing: concepts, process and practice, ed 4, St Louis, 1997, Mosby.)

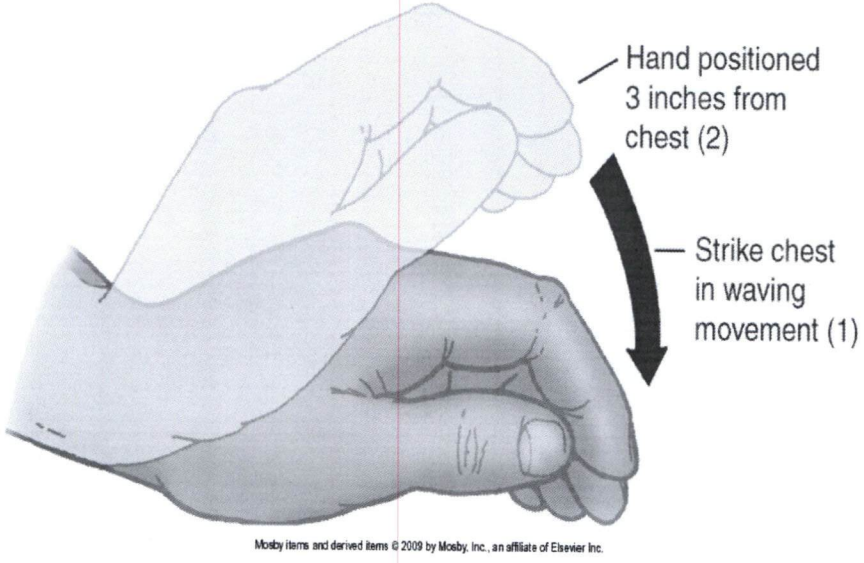
Percussion and Vibration



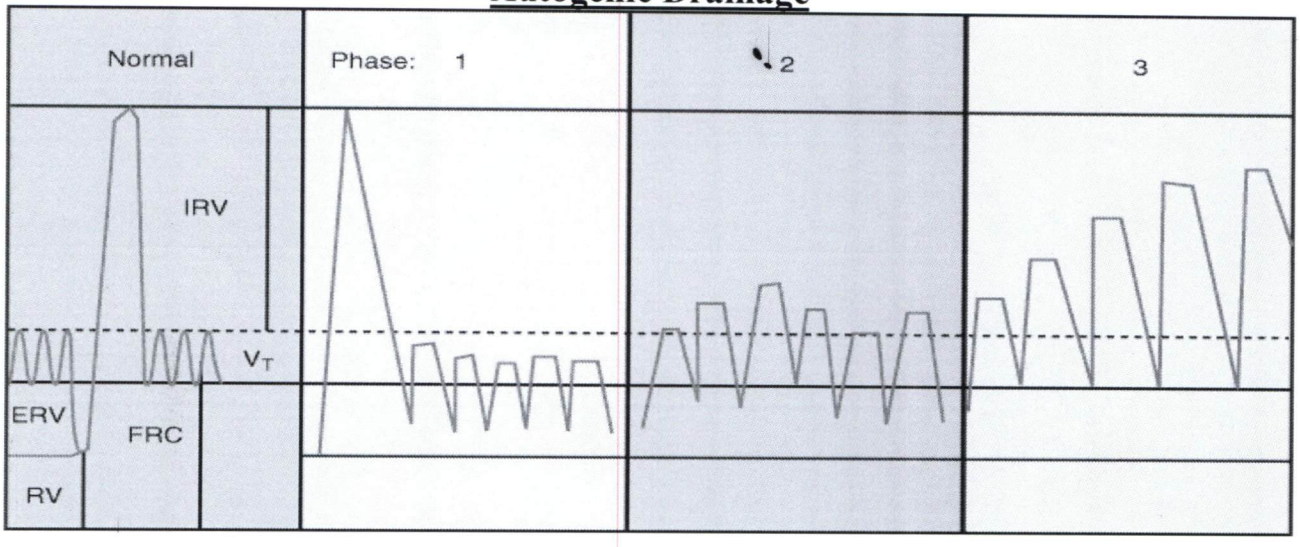




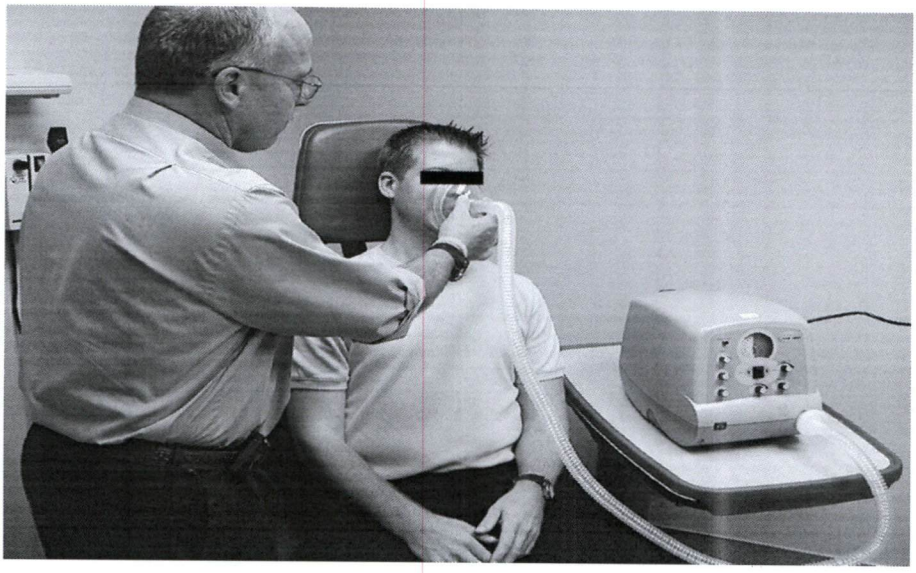
Active cycle of breathing (ACBT)



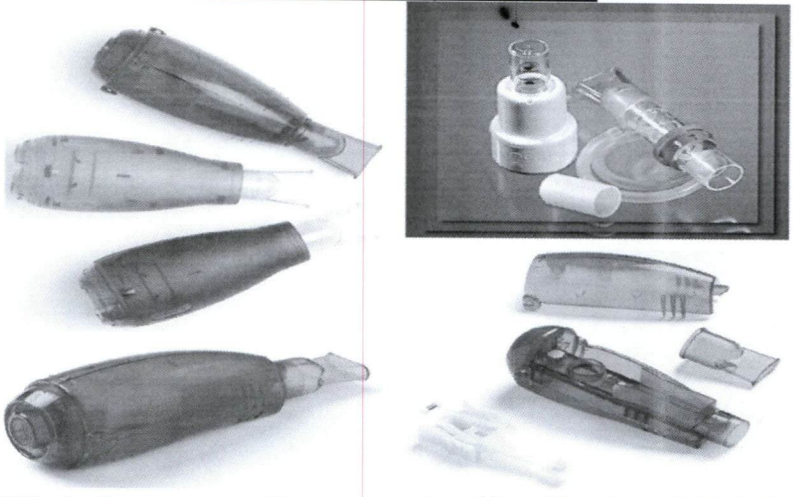
Autogenic Drainage



Mechanical insufflation-Exsufflation (MIE)

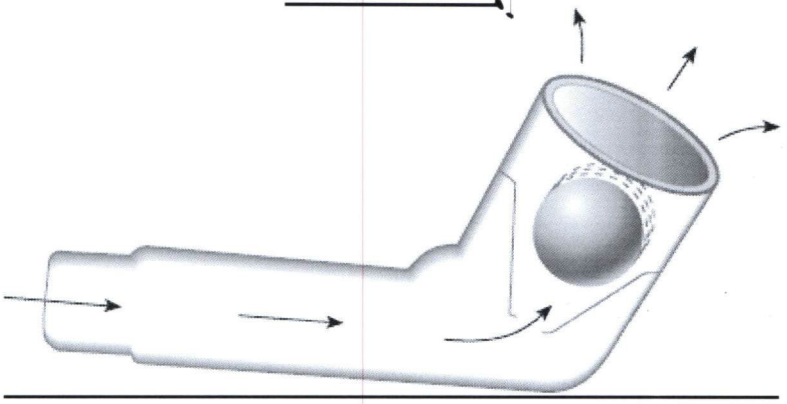


Positive Airway Pressure

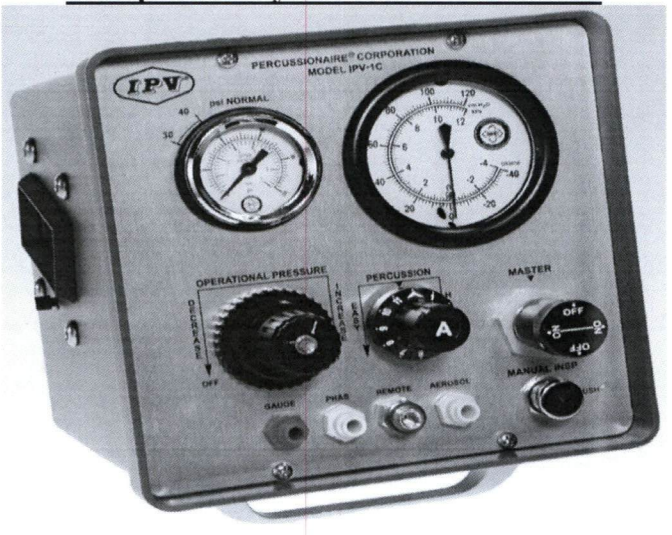


High-frequency Compression/Oscillation (VEST)

Flutter Valve



Intrapulmonary Percussive Ventilation



Appendix 2:
"BH-LET: Complications, Precautions and Adverse Reactions"

1. **When Hypoxia/Hypoxemia occurs**

   1.1 Administer higher concentration of oxygen before and during therapy, if the patient has a potential or history of falling arterial oxygen saturation.

   1.2 Increase the oxygen concentration if vigorous, paroxysmal, or violent coughing is precipitated. If increase in oxygen concentration fails to prevent or correct hypoxemia, administer maximal oxygen (i.e. 100%, if possible), discontinue the therapy, return the patient to an appropriate rest position (usually the one prior to therapy), ensure adequate ventilation, and notify the physician and nurse.

2. **In case of having a patient who is at risk of increase in 'Intracranial Pressure':**

   2.1 Closely monitor patients those who are at risk for change in neurological status, i.e. patients who have clotting or bleeding abnormalities.

   2.2 Assess the patient frequently for his or her tolerance of the therapy, especially for acute onset or worsening of headache.

   2.3 Monitor closely for changes in vital signs and other indicators of neurological status (i.e. Alertness and orientation).

   2.4 If changes occur, discontinue the therapy, return the patient to an appropriate rest position (usually the one prior to therapy), ensure adequate ventilation is provided, and notify the nurse.

   2.5 Consult the physician regarding a re-assessment of the risks to the patient versus the benefits of therapy.

3. **In the event of acute hypotension during the therapy:**

   3.1 Stop the therapy.

   3.2 Place the patient in the supine position or Trendelenburg position if his/her condition necessitates it and it is not contraindicated.

   3.3 Evaluate the patient needs for oxygenation and ventilation.

   3.4 Inform the physician and the bedside nurse.

4. **In the presence of signs of pulmonary hemorrhage during the therapy:**

   4.1 Stop the therapy immediately, return the patient to an appropriate rest position (usually the one prior to the therapy), and assist the patient as needed to maintain a proper airway and adequate ventilation.

   4.2 Notify the physician, nurse of the urgency of the situation, and remain with the patient until the physician responds.

5. **In the event of pain or injury to muscles, ribs or spine:**

   5.1 Stop therapy and consult physician in case of injury.

   5.2 Assure proper coordination of BH-LET with pain medication administration, it may serve to lessen the pain in patients. Assure the patient that you will not exceed his/her pain threshold.

   5.3 Modify techniques according to the patient's tolerance of the procedure. When discomfort becomes acute and is directly associated with the therapy, stop the treatment.

   5.4 Consult with the physician regarding a plan to minimize risks to the patient while optimizing achievement of the goals of therapy.

6. **In the event of vomiting and/or aspiration**

   6.1 Discontinue therapy.

   6.2 Position the patient on his/her side.

   6.3 Perform suctioning of the mouth if needed.

   6.4 Place the patient in an upright position, and administer oxygen as indicated.

   6.5 Consult with the physician.

7. **In the event of bronchospasm**

   7.1 Return patient to an appropriate resting position (usually the one prior to therapy)
   7.2 Oxygen administration as needed
   7.3 Consultation with the physician regarding the need to administer bronchodilators

8. **In the event of dysrhythmias**

   8.1 Assure the Dysrhythmias are associated with BH-LET, must be judged for clinical severity and cause. Baseline dysrhythmias does not preclude BH-LET.

   8.2 Attempt to prevent it by modifying therapy if ever possible.

8.3 If significant dysrhythmias develops, administer maximal oxygen (100% if possible), stop the therapy, and return the patient to an appropriate resting position (usually the one prior to therapy), and notify the physician and nurse immediately.

8.4 If dysrhythmias is life threatening, activate the emergency response team and begin CPR. Do not leave the patient until the situation is stabilized.

9. **In the event of excessive lung volume during mechanical ventilation**

9.1 Should the patient' volume become consistently greater than 10 ml/Kg of ideal body weight, return the patient to an appropriate resting position (usually the one prior to therapy), and re-evaluate the tidal volume.

9.2 In case of having a high tidal volume, decrease the inspiratory pressure to return tidal volumes to less than 10ml/kg of ideal body weight.

9.3 Consult with the physician regarding further need for adjustment of the ventilator parameters.

Prince Sultan Military Medical City

Department of Intensive Care Services

مدينة الأمير سلطان الطبية العسكرية

قسم خدمات العناية المركزة

Appendix 3: Common clinical signs, indicator and treatment

وزارة الدفاع
MINISTRY OF DEFENSE

Common Clinical Indicator	Chest Assessment				CXR	Treatment Selection (Physician Ordered)
	INSPECTION	PALPATION	PERCUSSTION	AUSCULTATION		
- Bronchospasm - e.g., asthma - Excessive Bronchial Secretions - e.g., bronchitis or cystic fibrosis - Bronchial Tumor	- Barrel chest - Use of accessory muscles - Pursed-lip breathing - Cyanosis	May show decrease chest excursion	May be hyper-resonant	Wheezes Prolonged exhalation	May be normal or show over expansion	- Bronchodilator therapy - Bronchial hygiene therapy General management/ comfort
Laryngeal edema e.g., croup or post extubation edema	Dyspneic cyanosis	Usually normal	Usually normal	Inspiratory strider	Laryngeal narrowing	- Cool, bland aerosol therapy - Racemic epinephrine
Large airway secretions e.g., bronchitis or cystic fibrosis	Sputum production	May be normal	May be normal	crackles	May be normal	Bronchial hygiene therapy
Air trapping (hyperinflation) e.g. COPD asthma emphysema	- Barrel chest - Use of accessory muscles - Pursed-lip breathing - Cyanosis	Decrease tactile and vocal fremitus	Hyper-resonant	- Prolonged exhalation - decrease breath sounds - decrease heart sounds	- Decrease diaphragm - Translucency - Over expanded	Treat underlying cause, if possible.
Consolidation e.g., pneumonia Atelectasis e.g., post-op or mucus plugs infiltration e.g. pneumoconiosis	May appear dyspneic Cyanosis	Increase tactile and vocal fremitus	dull	- Crackles - bronchial breath sounds	Opacity	- antibiotic agents - lung expansion Tx - bronchial hygiene therapy
Pulmonary edema Left heart failure	- Rapid shallow breath - cyanosis - frothy pink secretions	Usually normal	dull	- crackles May be: wheezes	- Enlarged heart - infiltrates "butterfly"	- lung expansion Tx - positive inotropic agents - diuretics
Tension pneumothorax	- Rapid shallow breath - cyanosis - unilateral expansion	- Usually normal - tracheal shift	Hyper-resonant	Absent or decrease breath sounds	- pneumothorax - translucency - mediastinum shift - decrease diaphragm	- lung expansion Tx - chest tube to evacuate air
- pleural effusion - empyema	- Rapid shallow breath - cyanosis - unilateral expansion	- Usually normal - tracheal shift	dull	decrease breath sounds	- opacity obscured diaphragm	- lung expansion Tx - thoracentesis
Flail chest	Paradoxical chest movement	tender	Not indicated	varies	- rib fractures - opacity (ARDS or atelectasis	- lung expansion Tx - stabilization of chest mechanical ventilation