Positive Expiratory Pressure

• Introduced in 1970s
• Used widely in Europe and Canada - relatively new in U.S.
• Defined as an airway clearance technique in which the patient exhales against a fixed-orifice flow resistor
• Helps to move _______________ into the larger airways for expectoration via coughing or swallowing

Positive Expiratory Pressure

• Technique
  – Assemble the PEP equipment.
  – Have the patient sit upright, with their elbows resting on a table in front of them.
  – Select the largest fixed orifice.
  – Encourage the patient to relax.
  – While performing diaphragmatic breathing, the patient is instructed to inspire a volume larger than normal, but not all the way to inspiratory capacity, through the device
Positive Expiratory Pressure

• Technique
  – Have the patient perform an ________________ for approximately 3 seconds.
  – Instruct the patient to exhale through the expiratory resistor to functional residual capacity (FRC).
  – Exhalation should be active by not forced. The therapist and the patient should observe the expiratory pressure indicator or manometer ensuring that ________ cm H₂O is generated throughout the majority of exhalation

Positive Expiratory Pressure

• Technique
  – Adjust the fixed orifice as needed to result in an inspiratory to expiratory ratio of approximately 1 to 3, while maintaining the desired PEP level. If the caregiver selects a port that is too large, exhalation will be too short, and the desired PEP level will not be attained. If the port selected is too small, the expiratory phase will be prolonged, work of breathing will be increased, leading to the risk of air trapping
  – A series of ______-______breaths is performed
Positive Expiratory Pressure

- **Technique**
  - After removing the PEP device, the patient performs several forced expiratory maneuvers ("huff coughs") to raise secretions
    - **Huff coughing** is a modified forced expiratory technique that is performed by forcefully exhaling through an open glottis from high to mid lung volumes. The patient takes in a slow, deep inhalation, followed by a 1-3 second breath hold. The patient then performs short, quick, forced exhalations with the glottis open. The patient may find it helpful to whisper the word "huff" during the exhalation. Younger children may be taught to flap their arms to their lateral chest as they perform the "huff" cough. This technique is sometimes referred to as the "chicken breath". This activity may help the child to focus on the forced exhalation and add enjoyment to the technique.

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- **Technique**
  - This cycle of 10-20 PEP breaths, followed by huff coughing, is repeated ______-______ times per PEP therapy session
  - Sessions last approximately 10-20 minutes, and should be performed 1-4 times per day as needed.

Positive Expiratory Pressure

- **EzPAP**
  - Popular replacement for IPPB
    - Provides limited inspiratory pressure, positive hold pressure and positive expiratory pressure
    - Based on the principle of collateral ventilation
  - Works on the ____________ effect and opposing flow to create positive expiratory pressure
  - Can include a nebulizer for the delivery of respiratory medications
Positive Expiratory Pressure

• Indications for PAP devices
  – To reduce ______________
  – To prevent or reverse ______________
  – To aid in secretion mobilization
  – To optimize delivery of bronchodilators in patients receiving bronchial hygiene therapy

• Contraindications for PAP Devices
  – Although no absolute contraindications have been identified, the following should be evaluated:
    - Pts ability to tolerate increased ______________
    - ICP >20 mmHg
    - Hemodynamic instability
    - Acute sinusitis
    - Active hemoptysis
    - Middle ear pathology
    - Recent facial, oral or skull surgery or trauma
    - Epistaxis
    - Esophageal surgery
    - Nausea
Positive Expiratory Pressure

• Hazards and Complications of PAP
  – Pulmonary __________
  – Increased ICP
  – Cardiovascular compromise
  – Skin breakdown/discomfort from mask
  – Air swallowing, vomiting and aspiration
  – Claustrophobia
  – Increased __________ leading to hypoventilation and hypercarbia

Positive Expiratory Pressure

• Assessment of Need for PAP
  – Sputum retention not responsive to coughing
  – Decreased breath sounds or presence of adventitious sounds
  – Change in vital signs (increased f, tachycardia)
  – Abnormal CXR consistent with atelectasis or infiltrates
  – Deterioration of ABG values or oxygen saturation

Positive Expiratory Pressure

• Assessment of Outcomes for PAP
  – Change in sputum production
  – Change in breath sounds
  – Pt subjective response to therapy
  – Change in vital signs
  – Change in CXR
  – Change in ABG values or oxygen saturation
Positive Expiratory Pressure

- Monitoring the Patient on PAP
  - Pt subjective response
  - Pulse rate/BP
  - Mental function
  - Breath sounds/breathing patterns
  - SpO₂/ABGs
  - Sputum production
  - Skin color
  - ICP (if indicated)