OBJECTIVES

- To present common pediatric cases with clear indications for airway clearance therapy (ACT)
- To compare the different mucolytics used for ACT and their appropriate use.
- To discuss the benefits of manual and mechanical chest physiotherapy in improving airway clearance.

DEFINITION

- Mucus: water and glycoprotein + serum + cellular proteins and lipids
  - cleared by airflow and ciliary movement.
  - ciliary movement – depends on temperature, mucus gel and periciliary fluid hydration.

- Sputum: mucus + inflammatory cells, cellular debris, DNA and bacteria
  - removed by cough.

AIRWAY CLEARANCE THERAPY

- Removal of sputum by internal and external manipulation of airflow and expulsion of sputum by coughing.

WHEN DOES MUCUS CLEARANCE BECOME A PROBLEM?

Respiratory infection and inflammation - hyperplasia and hypertrophy of the goblet and submucosal gland → increase mucus secretion + products of inflammation + bacteria → increase Sputum → mucus plugging.
WHEN DOES MUCUS CLEARANCE BECOME A PROBLEM?

1. chronic inflammation or chronic infection
2. dehydration of mucosa
3. alveolar dysfunction
4. airflow disorder
5. inability to cough

COMMON PULMONARY DISORDERS REQUIRING ACT

Bronchiectasis
- CF and non-CF

Recurrent atelectasis

Spinal Muscular Atrophy
Pediatric Grand Rounds - UT Health SA 4/6/2018

**Mucoactive Agent Mechanism of Action**

1. **Expectorants**: Hypertonic saline
2. Classical mucolytics: N-acetylcysteine
3. Peptide mucolytics: Dornase
4. Mucoregulatory agent: Anti-cholinergic agent; Macrolide
5. Cough clearance promoters: Bronchodilators

<table>
<thead>
<tr>
<th>Therapy</th>
<th>Age range</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Percussion and Postural drainage</td>
<td>All ages</td>
<td>No cost; no equipment; target specific areas</td>
<td>Requires caregiver; tiresome</td>
</tr>
<tr>
<td>Blowing games</td>
<td>18 mo- 5 years</td>
<td>Low cost</td>
<td>Needs appropriate cognitive ability</td>
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**Methods of Airway Clearance**

**Therapy**

1. **Expectorants**: Hypertonic saline
   - Mechanism of Action:
     - Hydrates secretion
     - Divides disulfide bond linking mucin oligomers
     - Hydrolyzes DNA polymer with reduction in DNA length
     - Decreases volume of stimulated secretions
     - Decreases airway inflammation and mucin secretion
     - Improves cough by increasing expiratory flow.
### Methods of Airway Clearance

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<td>Huff cough</td>
<td>&gt; 3-4 years</td>
<td>Gentle coughing</td>
<td>None</td>
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<tr>
<td>Active cycle breathing technique (ACBT)</td>
<td>&gt; 4 years</td>
<td>Independent, can be done anywhere, anytime</td>
<td>Pt must have cognitive ability</td>
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<tr>
<td>Autogenic drainage</td>
<td>&gt; 8 years</td>
<td>Independent; can be performed anywhere</td>
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#### ACTIVE CYCLE BREATHING TECHNIQUE

- Is a breathing technique using breathing control, deep breathing and huff coughing

- **Cycle:**
  - Inhale through the nose, exhale through the mouth
  - 3-4 normal sized breaths
  - Make a full inspiration
  - Hold breath x 3 sec
  - Relaxed expiration
  - Repeat
  - Huff cough
### Methods of Airway Clearance

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#### AUTOGENIC DRAINAGE

- Breathing technique which helps drain the lungs by breathing at different volumes in 3 phases
- **Phase 1**: loosening the secretions in the small airways
  - Breathe through the nose, breathe out through the mouth
  - Take a deep breath, hold for 3-4 sec then exhale
  - Take a small breath, hold for 3 sec
  - Exhale and squeeze as much air as possible
  - Repeat 3 times.
- **Phase 2**: moving secretions to mid-airways
  - Take a deep breath, hold for 3 sec and exhale (not very low)
  - Take a larger breath through the nose, hold for 3 sec
  - Exhale
  - Repeat 3 normal sized breaths
- **Phase 3**: moving the secretions by huff coughing

#### Handheld devices: PEP, oscillating PEP

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<td>PEP</td>
<td>&gt; 4 years old</td>
<td>Low cost; promotes independence</td>
<td>Pt must have cognitive ability</td>
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<tr>
<td>Intrapulmonary percussive ventilation (IPV)</td>
<td>&gt; 5 yrs (non-intubated, non-tracheostomized)</td>
<td>Can nebulize medication while performing, non-intubated/non-tracheostomized</td>
<td>Expensive</td>
</tr>
<tr>
<td>HFCWO/HFCC</td>
<td>Can start at 3 months old (depends on the size of chest)</td>
<td>Promotes independence, portable, administer neb treatments at the same time, non-intubated/non-tracheostomized</td>
<td>Expensive</td>
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#### PEP DEVICE

- **TheraPEP**
- **EziPEP**
- **AcurAPPE**

#### Vibratory/Oscillatory PEP

- **Flutter® Device**
- **Aeribell®**
- **Acapella® choice Device**
### Methods of Airway Clearance

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- Handheld devices: PEP, oscillating PEP

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<th>Intrapulmonary percussive ventilation (IPV)</th>
<th>&gt;5 years old non-intubated infants; intubated/trached</th>
<th>Can nebulize medications while performing Expensive</th>
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- Intrapulmonary percussive ventilation (IPV)

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<th>HFNC/HFCE</th>
<th>Can start at 3 months old (depends on the size of chest). Term neonates can use wrap type</th>
<th>Promotes independence; neb treatments at the same time; non-intubated/intubated/trached</th>
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- HFNC/HFCE

### INTRAPULMONARY PERCUSSIVE VENTILATION (IPV)

### IPV DEMO IN LAB
### Methods of Airway Clearance

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<tr>
<td>Intrathoracic percussive ventilation (IPP)</td>
<td>&gt;5 y/o (non-intubated, non-tracheostomized)</td>
<td>Can nebulize medications while performing; non-intubated/intubated and tracheostomized</td>
<td>Expensive</td>
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<td>Promotes independence; neb treatments at the same time; non-intubated/intubated/tracheostomized</td>
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### HFCWO ON A CHILD

#### HFCWO devices

![HFCWO devices image](image)

**HIGH FREQUENCY CHEST WALL OSCILLATION (HFCWO)**

![HFCWO device](image)
CONTRAINDICATIONS

- Pneumothorax
- Hemoptysis
- Bronchospasm
- Immediate post-op- tracheostomy, thoracic and abdominal surgery
- Severe nausea and vomiting
- Severe intracranial pressure
- Unstable rib and spine fracture

QUESTIONS TO ASK BEFORE PRESCRIBING

1. What therapy is best for the age of my patient?
2. What therapy is best for the stage of lung disease of my patient?
3. What therapy will my patient do?
4. Which therapies will be covered by my patient's insurance?

SAMPLE PRESCRIPTION

“bronchodilator→ hydrate/shake→ anti-inflammatory/medicate”

- ALBUTEROL 1 VIAL Q 4H→ HYPERTONIC 7% 12 ML Q4H WITH IPV/VEST
- COUGH ASSIST Q4H→ PULMOZYME 1 VIAL Q12→ PULMICORT Q12H
- INHALED TOBRAMYCIN Q12H

- THESE ARE ITEMS BILLED TO INSURANCE:
  - VENTS:                $1800.00 PER MONTHLY RENTAL
  - CPAP:                 $900.00 PURCHASE IF ALLOWED BY INSURANCE 140.00 PER MONTHLY RENTAL
  - BIPAP:                $280.00 RENTAL
  - PARI NEB              $ 99.00 PURCHASE
  - 50 PSI:                $71.66 RENTAL
  - COUGH ASSIST:        $535.00 PER MONTHLY RENTAL
  - IPV:                    $ 940.00 PER MONTHLY RENTAL
  - VEST:                   $ 8000.00 APPROX.
  - ACAPELLA DEVICE       $50.00
WHAT CONDITIONS ARE COVERED BY INSURANCE?

- Cystic fibrosis
- Chronic bronchitis
- Bronchiectasis
- NMD (Duchenne muscular dystrophy, Spinal muscular atrophy, Amyotrophic lateral sclerosis)

WHAT CONDITIONS ARE NOT COVERED BUT CAN BE JUSTIFIED?

- Primary ciliary dyskinesia
- Aspiration syndromes
- Recurrent atelectasis/pneumonia requiring frequent hospitalizations

** Document: **

1. Failure to improve after manual CPT has been tried.
2. Caregiver is unable (mentally and physically) to perform manual CPT.
3. No available alternate person to perform manual CPT.

Thank you!

Joel's Physio Routine
30 mins everynight