Mechanical CoughAssist Clinical Utility

May 2017

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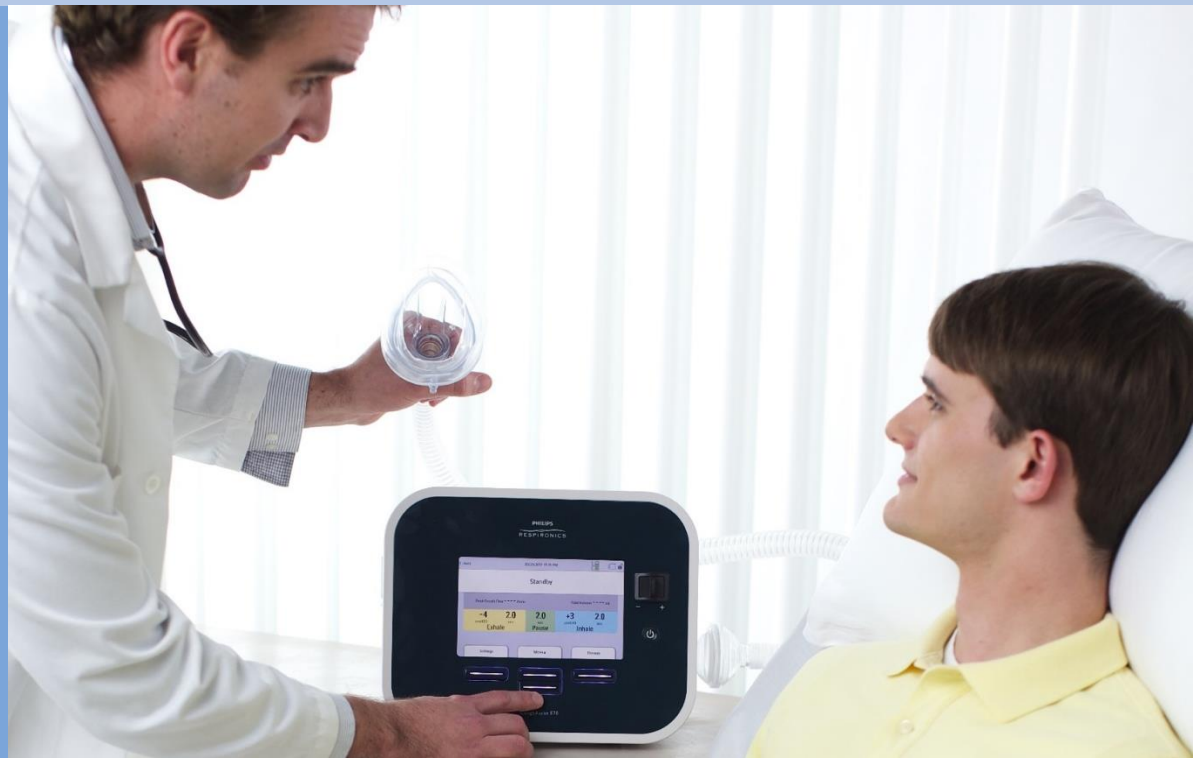
Content

- Physiology of Airway Clearance
- Pathophysiology of Airway Clearance
- General Goals and Indications of Airway Clearance Therapy
- CoughAssist T70: Indications and Contra-Indications
- CoughAssist T70 Typical Treatment



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Some Clinical Facts

“… over

90%

of episodes of respiratory failure in patients with muscular dystrophy are caused by ineffective coughing during intercurrent chest colds. Most people with neuromuscular diseases still die prematurely or are hospitalized and undergo tracheotomy, because of failure to assist respiratory muscles to prevent respiratory failure.”

Bach JR. Mechanical insufflation/exsufflation: has it come of age? A commentary. ***Eur Respir J 2003****; 21:385-386*

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Some Clinical Facts

> “Neuromuscular diseases (NMD) cause muscle weakness that can affect […] breathing, coughing […], all of which can cause disability and compromise quality of life. […]. Weakness of breathing and coughing muscles, however, continues to be the major cause of repeated hospitalizations and loss of life.”

Bach JR, Extract from the preface of the book
“Management of Patients with Neuromuscular Disease

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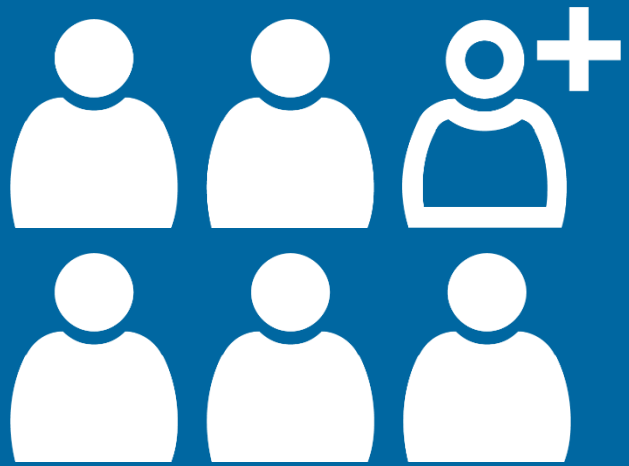
Some Clinical Facts

“A growing number of children with NMD are surviving to adulthood with the aid of ventilatory support.
The combination of NIV with cough-assist techniques decreases pulmonary morbidity and hospital admissions.”

Simonds A. Recent Advances in Respiratory Care for Neuromuscular Disease, **Chest 2006**; 130:1879–1886



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Physiology of Airway Clearance

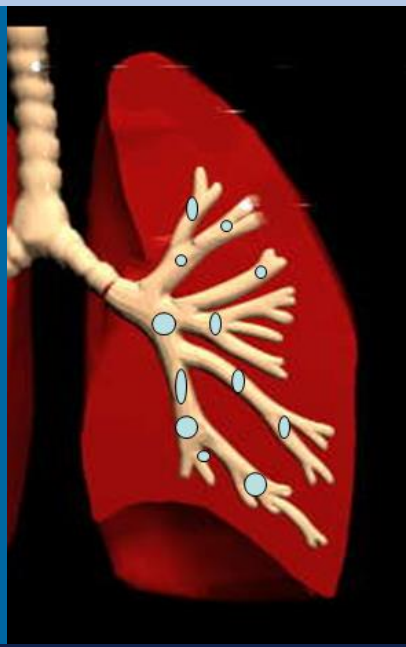
Mucociliary Clearance

Escalator mechanism in which mucus is moved in the direction of the airway opening

Cough Clearance

Clearance from the central/upper airway of inhaled foreign materials and secretions captured in the mucociliary system.

The cough is one of the most important protective reflexes. It clears the larger airway from excessive mucus and/or foreign matter.



Two separate, but connected mechanisms

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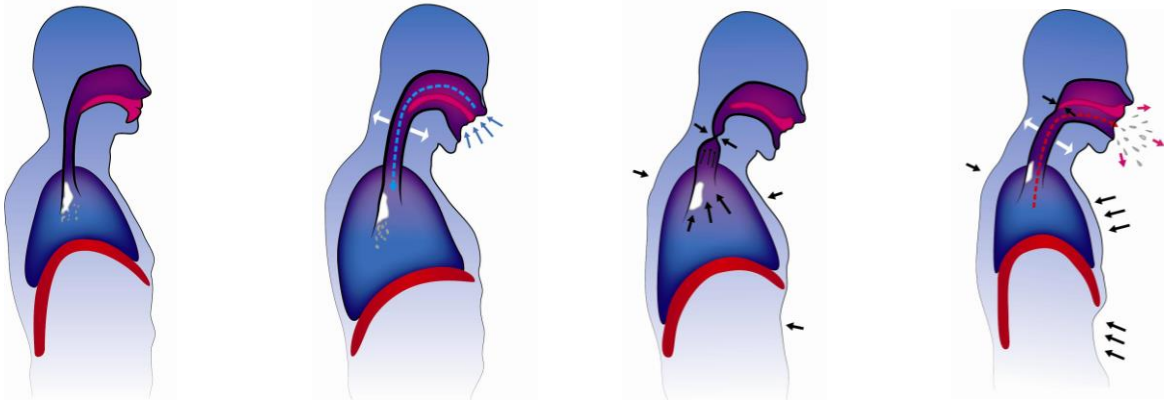
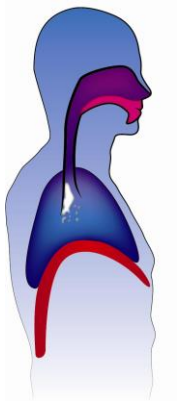
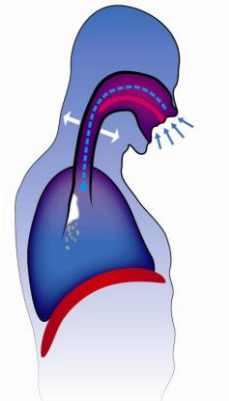
Normal Cough

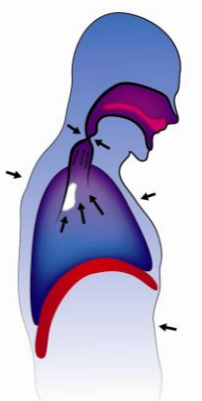


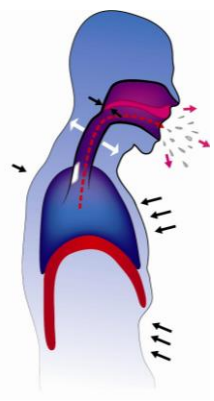
Cough Phases	Irritation	Inspiratory Phase	Compressive Phase	Expulsive Phase	PCEF 360~1000 LPM
Function		Inflation of the lungs close to TLC	0,2 sec. glottis closure (50-100 cmH_2O intrapulmonary pressure)	Reaching PCEF (within 30-50ms)	6-14 L/sec
Muscles groups involved		Diaphragm Intercostals	Bulbar Various Arytenoids	Abdominal Others accessory expiratory muscles	

Cough Impairment









Irritation

Sensitivity loss

Inspiratory Phase

Decreased Vital Capacity

Compressive Phase

Glottis function impairment

Decreased VC

Expiratory muscles weakness

Expulsive Phase

Inefficient expiratory peak flow
- Decreased VC
- Expiratory muscles weakness

Sticky mucus

Increased resistance in the upper airways

Goals and Indications of Airway Clearance Therapy

The primary goal of airway clearance therapy is to help mobilize and remove retained secretions, with the ultimate aim to improve gas exchange, promote alveolar expansion, and reduce the work of breathing.

Secretion Mobilization

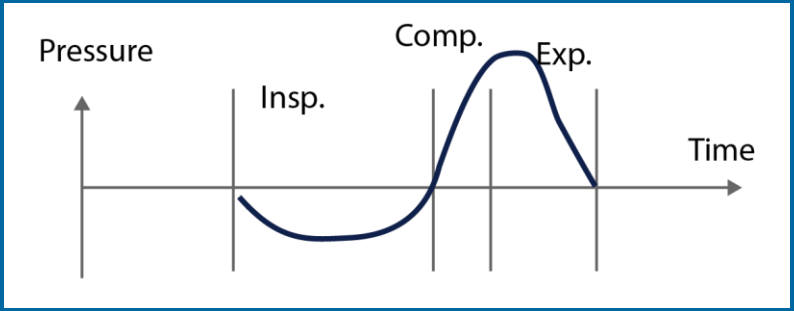
Devices/techniques that help loosening secretions in case of thick phlegm so that patient **who can cough** can more easily clear his secretions.

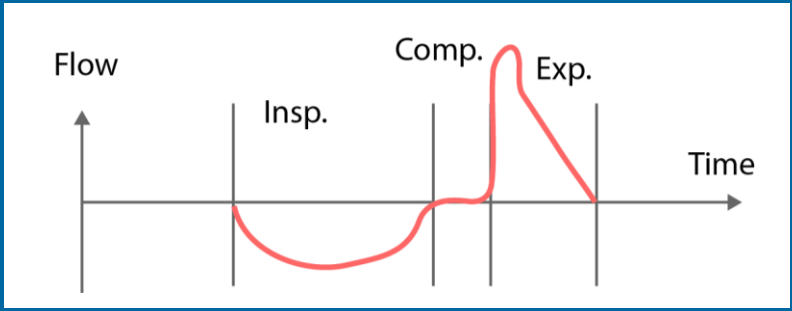
Secretion removal

Replace a cough when patients cannot cough whether the secretions are thick or loose, it does not change the structure of the phlegm but just makes a cough.

Evaluate Cough Efficacy

Normal Cough





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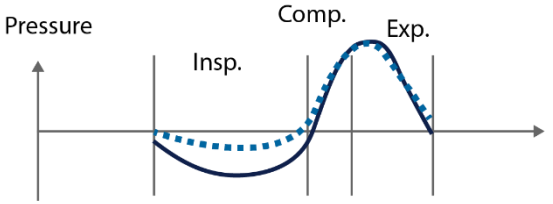
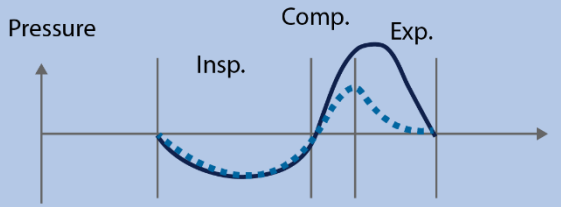
Evaluate Cough Efficacy

Insp. = Inspiration Phase Comp. = Compressive Phase Exp. = Expulsive Phase

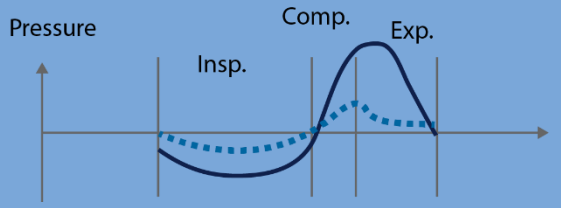
Insufflation assistance, Lung Volume Recruitment (LVR)



Manual Assisted Cough (Respiratory Therapist)



Insufflation and Exsufflation assistance



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Lung Volume Recruitment Techniques

- Glosso pharyngial breathing, *Frog*
- Resuscitator, *Ambu®*
- Intermittent Positive Pressure Breathing (IPPB), Bird
- Home pressure ventilator, *Hyperinsufflation*
- Home volume ventilator, *Air Stacking*
- Mechanical Insufflation-Exsufflation (MI-E), CoughAssist

To compensate the low vital capacity of patient

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Evaluate Cough Efficacy

- The goal of inspiratory pressure is to give patient a good hyper-expansion
- Cough expels volume of air that is > 4 times normal V_t
- Pressures and times vary with each patient
- Neuromuscular disease – reduced VC and V_t and an inability to sigh that result in developing atelectasis and pneumonia[1]
- Provides normal hyperinflation – has been shown to combat loss of chest wall compliance and microatelectasis[2]

1. Estenne M. et al**.** *Lung volume restriction in patients with chronic respiratory muscle weakness: the role of microatelectasis*. **Thorax 1993**:48(7):698-701.
2. Estenne M. et al. *Chest wall stiffness in patients with chronic respiratory muscle weakness.* **Am Rev Respir Dis 1983**;128(6):1002-1007.

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Manual Assisted Cough

- Performed by the physiotherapist
- Various positions and techniques

Deep Suctioning

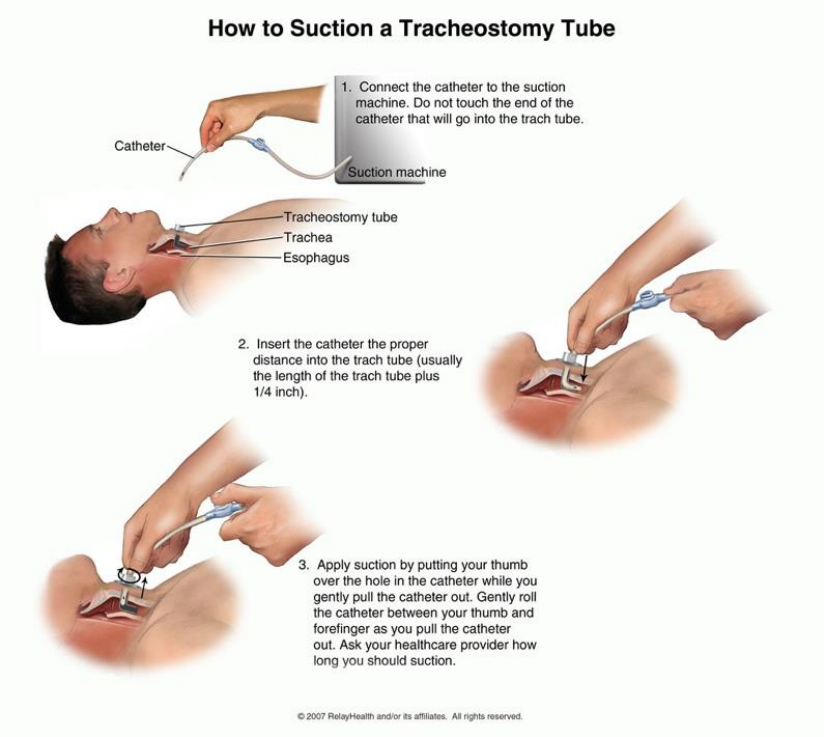
Pros

- Costs
- Training

Cons

- Invasive procedure
- Misses left main stem bronchus 90% of the time
- Tracheal trauma, suctioning induced hypoxemia, hypertension, cardiac arhythmias and raised intracranial pressure have all been associated with suctioning
- Patients have reported that suctioning can be a painful and anxiety provoking procedure

Thompson, L. *Suctioning Adults with an Artificial Airway. The Joanna Briggs Institute for Evidence Based Nursing and Midwifery*; **2000. Systematic Review** No. 9.



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What does CoughAssist T70 do?

Taking your Airway Clearance to the Next Level

1. **Non invasive alternative to deep suction**
   Can be given via facemask, mouthpiece, endotracheal or tracheostomy tube

2. **Simulates a cough**
   By applying a positive pressure (deep insufflation) to the airway followed by a rapid shift to a negative pressure to produce expiratory flow from the lungs and effectively remove secretions

3. Approved for **adult** and **pediatric** populations*

* The CoughAssist T70 device is not intended for neonates or premature infants.

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What does CoughAssist T70 do?

Taking your Airway Clearance to the Next Level

4. Assists patients with **loosening and clearing** retained secretions.
   With the Oscillation feature (set to inhale/exhale or both) as well as the Auto Advanced Mode

5. Allow **Data management**
   Peak Cough Flow, Insufflation Volume, SpO_2 on screen and trend review for long term follow-up

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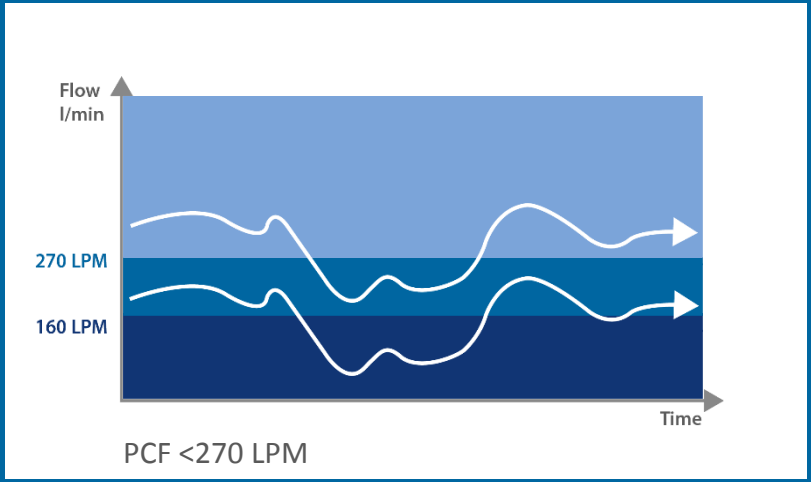
Indications for use of MI-E

Any patient unable to cough or clear secretions effectively due to reduced peak cough expiratory flow

PCF < 160 LPM (Bach JR et Al, Chest 1996)

PCF < 240 – 270 LPM (American Thoracic Society Documents Respiratory Care of the Patient with Duchenne Muscular Dystrophy ATS Consensus Statement 2004/ Bach JR et Al, Chest 1997)



PCF <270 LPM

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Relevance of Measurements

PCF<160L/min	No functional cough	High risk
PCF 160-270 L/min	No functional cough	Moderate risk
PCF 270-360 L/min	Weak cough	Low risk
PCF>360 L/min	Effective cough	No risk

Data shown during JIVD 2012 symposium on Airway clearance

Other parameters:

- Max Expiratory Pressure < 45-60 cmH_2O (40-50 % theory)
  - ATS Consensus statement 2004; G Lopes et al. Eur Respir J 2000; 16: 37s
- Forced Vital Capacity < 1,5-2 L (30-50% theory)
  - JR Bach et al. Chest, 1996; G Lopes et al. Eur Respir J 2000; 16: 37s

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Targeted Patients

Targeted at Patients with Neuromuscular Disorders and Spinal Injuries

- Muscular dystrophy (Duchenne)
- Myasthenia gravis
- Poliomyelitis
- Spinal cord injury
- Amyotrophic Lateral Scerosis (ALS)
- Spinal Muscular Atrophy (SMA)

In the ICU environment, enlarged to obstructive patients that behave like restrictive patients*, using oscillations feature that release mucus from the bronchial walls, increasing mobilization

* Trach patients, anyone being suctioned, anyone with weakness who does not have lung disease

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Contraindications

- Bullous emphysema
- Pneumothorax or pneumo-mediastinum
- Recent Barotrauma

When using the Oscillation feature, if the patient has any of the following conditions, it is advised to consult the health care professional before using the device:

- Current or recent pneumothorax or pneumo-mediastinum
- Interstitial lung disease
- Recent lung surgery
- Pleural lung disease
- Acute Respiratory Distress Syndrome (ARDS)
- Acute Severe Lung Injury
- Bronchopulmonary Dysplasia
- Infant Respiratory Distress Syndrome

Note: Patients with hemodynamic instability should be carefully monitored

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Clinical Guidelines

More and more scientific societies are specifically recommending the use of mechanical in-exsufflation technique for airway clearance management.

Some examples:

- Guidelines for Respiratory Management of Children with Neuromuscular Weakness, **British Thoracic Society**. Thorax July 2012 67: i1-i40.
- Home Mechanical Ventilation, **A Canadian Thoracic Society** Clinical Practice Guideline,
  Can Respir J Vol 18 No 4 July/August 2011
- **AARC** Clinical Practice Guideline: Effectiveness of Non Pharmacologic Airway Clearance Therapies in Hospitalized Patients, Respiratory Care Journal, Dec 2013, Vol 58 N°12

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Typical CoughAssist T70 Treatment

Therapy Plan:

- Cough cycle = Inhale + Exhale + Pause
- Sequence = 3 to 6 cough cycles given in rapid succession
- Resting time = Patient rests for 20 – 30 seconds
- During rest, clear secretion that are visible in the mouth, throat or tracheostomy tube
- Repeat above sequence 3 – 6 times or until secretion expelled

Refer to the CoughAssist 70 Series suggested protocol for more information regarding treatment options

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Typical CoughAssist T70 Treatment

Example of settings:

- Pressures (positive and negative)
  - Start low, 10 to 15 cmH_2O while oscillations set at patient comfort
- Get patient familiar with the device
- Increase pressures as tolerated, 35 to 45 cmH_2O ideally*
- The goal of expiratory pressure is to replace a good expiratory cough flow
  - Possibility to use abdominal and chest compression during expiration
- Higher pressures are often required when compliance decreases or resistance increases (small tracheal tubes, obesity, scoliosis)

* Studies have shown that therapeutic PCF may not be reached with MI-E expiratory pressures less than -40 cmH_2O

Winck JC, et al. *Effects of mechanical insufflation-exsufflation on respiratory parameters for patients with chronic airway secretion encumbrance*. **Chest. 2004**;126:774-780.

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Typical CoughAssist T70 Treatment

Hints:

- Therapy has to be adjusted to the need of each individual patient: Use presets for different needs of therapy
- Best before meals and at bedtime
- Frequency of sessions according to case history
- Necessary adaptation for invasive use: Possible higher pressure needed

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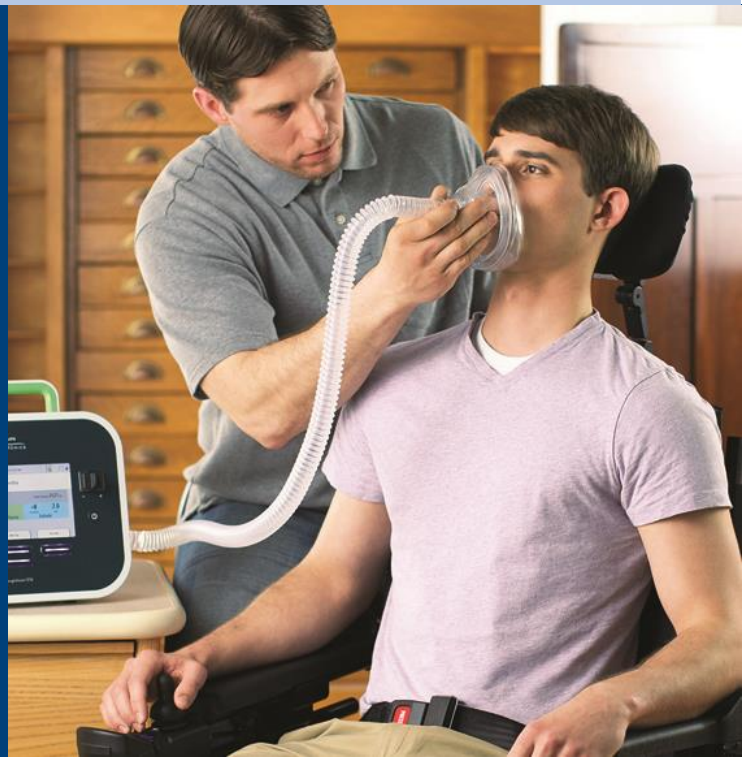
Typical CoughAssist T70 Treatment

Hints:

- Use Cough-Trak to improve patient/device synchronization and overall patient comfort
- Use the Oscillation feature to enhance the efficacy of the clearance treatment, specifically in patients with more sticky secretions
- Use the Advanced Auto Mode if there is a need to precede the cough therapy with some lung volume recruitment to further improve the outcomes of the treatment.
- Look at the flow waveforms on DirectView to troubleshoot a difficult patient or to validate the settings.



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