CoughAssist mechanical insufflation-exsufflation (MI-E) approach to secretion management

1 AARC CEU credit

As Allies in Better Sleep and Breathing, we make it our #1 priority to work in harmony with caregivers and patients to establish:

• healthier patients by accelerating adoption, maximizing therapy effectiveness and promoting long-term compliance
• healthier practices by enabling care team collaboration and creating easy access to critical information
• healthier businesses by streamlining patient management and increasing efficiency

Objectives

• Understand the indications, contraindications and warnings/cautions for the use of CoughAssist mechanical insufflation-exsufflation (MI-E)
• Identify the advantages of using the noninvasive CoughAssist MI-E device over invasive airway clearance
• Review a clinical case study
• Discuss the recommended treatment plan
Airway clearance

- Oscillation devices
- Positive expiratory pressure
- Manual assisted cough
- Breathing techniques
- High-frequency chest-wall compression
- Chest physiotherapy
- Suctioning
- CoughAssist MI-E

Secretion removal techniques and devices
- Suction
- Manually-assisted cough
- MI-E: CoughAssist
**Suctioning**

- Invasive procedure
- Misses left main stem bronchus 90% of the time
- Tracheal trauma, suctioning induced hypoxemia, hypertension, cardiac arrhythmias 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. 10.

**Manually-assisted cough**

- Performed by respiratory therapist
- Various positions and techniques

**Indications for use**

CoughAssist mechanical insufflation-exsufflation is intended for use on adult or pediatric patients unable to cough or clear secretions effectively. It may be used either with a facemask or mouthpiece, or with an adapter to a patient's endotracheal or tracheostomy tube. The device is intended to be used in the hospital, institutional environment, or in the home.

- PCF < 160 LPM (Bach JR et al., Chest 1996)

**Flow vs. Time**

Peak flow meter
Introduction

- The CoughAssist T70 mechanical insufflator-exsufflator assists patients in clearing retained secretions by applying a positive pressure to the airway, then rapidly shifting to a negative pressure.
- This rapid shift in pressure produces a high expiratory flow rate from the lungs.

Introduction

- The treatment can be delivered via facemask, mouthpiece or endotracheal or tracheostomy tube.
- It is effective for both invasive and non-invasively ventilated patients.
- Intended for use by adult and pediatric populations.
Application of CoughAssist T70 MI-E

- Patients with an ineffective cough due to neuromuscular disorders
- Patients with paralysis of the respiratory muscles such as a high spinal cord injury
- Patients that have an ineffective cough due to respiratory fatigue associated with intrinsic lung disease
- In the acute and chronic care setting—neuromuscular disease patients in respiratory failure
  - Avoid intubation
  - Facilitate extubation and decannulation
  - Prevent post-extubation failure

Benefits from the literature

- Increase peak cough expiratory flows more than 80%\(^1\)
- Recommended for use to reduce recurrent respiratory infections in patients with respiratory weakness from neuromuscular disease\(^2\)
- Patients prefer MI-E to suctioning for comfort and effectiveness\(^2\)

Patient indications

- Patients with neuromuscular diseases and spinal injuries
  - Muscular dystrophy (Duchenne)
  - Myasthenia gravis
  - Poliomyelitis
  - Spinal cord injury
  - Amyotrophic lateral sclerosis (ALS)
  - Bronchiectasis
  - Spinal muscular atrophy (SMA)
Contraindications

- Bullous emphysema
- Pneumothorax or pneumomediastinum
- Recent barotrauma

General information:
Patients need to be cooperative unless they have an artificial airway.

CoughAssist T70 MI-E device

Product overview
Redefining noninvasive secretion clearance to help improve patient’s lives

New feature:
- Cough-Trak algorithm

Large color and intuitive user interface

Monitoring and data management tools
- Monitoring display of peak cough flow and Vti (insufflated volume) at each cycle
- Internal memory and SD card (therapy data including waveforms visible on DirectView from 2.0)

New optional accessories include a foot pedal, integrated detachable battery, and oximetry interface cable.
**CoughAssist T70 MI-E device**

- **Noninvasive alternative to deep suctioning**
  - Can be used with a facemask, mouthpiece, endotracheal or tracheostomy tube
- **Simulates a natural 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
- **Assists patients with clearing of retained secretions**
- **Allows data management**
  - Peak cough flow, tidal volume, SpO2 on screen and trend review for long titration and long-term follow-up

---

**Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Automatic model</th>
<th>Manual model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>5, 5, 5</td>
<td>NA</td>
</tr>
<tr>
<td>Cough Trg</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Intake pressure</td>
<td>9 to 75 cm H2O, in increments of 1 cm H2O</td>
<td>0 to 40 cm H2O, in increments of 5 cm H2O</td>
</tr>
<tr>
<td>Intake flow rate</td>
<td>Low/Normal/High</td>
<td>Low/Normal/High</td>
</tr>
<tr>
<td>Exhale time</td>
<td>0 to 5 s, in increments of 5 s</td>
<td>0 to 5 s, in increments of 5 s</td>
</tr>
<tr>
<td>Exhale pressure</td>
<td>0 to 25 cm H2O, in increments of 1 cm H2O</td>
<td>0 to 25 cm H2O, in increments of 1 cm H2O</td>
</tr>
<tr>
<td>AC voltage input</td>
<td>100 to 240 VAC, 50/60 Hz</td>
<td>10 VDC</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>319 x 273 x 199</td>
<td>319 x 273 x 199</td>
</tr>
<tr>
<td>Weight</td>
<td>3.0 kg (3 kg with battery)</td>
<td>3.0 kg (3 kg with battery)</td>
</tr>
</tbody>
</table>

---

**Accessories**

**Accessories and Monitoring**

<table>
<thead>
<tr>
<th>Product</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote control (Optional)</td>
<td>Compatible with a foot pedal</td>
</tr>
<tr>
<td>Oximetry capability (Optional)</td>
<td>SpO2 and HR displayed on screen in Standby mode</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Peak inflation volume displayed on screen during Therapy, updated at each cycle</td>
</tr>
<tr>
<td>Battery back-up (Optional)</td>
<td>External battery: autonomy is ~1 day of treatment</td>
</tr>
</tbody>
</table>
New features to advance airway clearance

Cough-Trak

Data management

Cough-Trak trigger

Clinical aim
- The integrated Cough-Trak trigger aims to support device titration and patient synchronization, helping both comfort and compliance

How
- Allows patient to trigger a full cough upon every inspiration; algorithm will:
  - detect patient trigger upon inhale
  - initiate an inspiration for the set inhale time
  - automatically switch to exhale for the set exhale time
  - wait for the next patient-initiated inhale (no pause time)

Settings
ON/OFF

Cough-Trak trigger

Pressure
Inhale time set
Exhale time set
No pause time set
Patient triggering
Pause time varies from one cycle to another

Cough-Trak Off
Pressure
Inhale time set
Exhale time set
Pause time set
Timing triggering
Cough-Trak trigger

Requirements for a comfortable and efficient mechanical in-exsufflation

- Patient/CoughAssist T70 synchronization
  Ability of CoughAssist T70 to follow patient cough rhythm
- Adaptation to patient needs
  Patient needs may vary over time (weakness, treatment, progress of the disease)

Philips Respironics' answer

- Cough-Trak inspiratory trigger
  Automatic detection of patient's inhale needs
  Patients who can trigger ventilators are good candidates for using the Cough-Trak triggering algorithm
  Technology inherited from Auto-Trak

Benefits for the clinicians

- No need to set a sensitivity regardless of the patient's respiratory mechanics
- Patient/CA T70 synchronization provided

Therapy monitoring solutions

Monitoring

Peak cough flow and Vti (insufflated volume) monitored and recorded
Values displayed for each cycle during therapy

Optional oximetry connectivity

Instant, easy and noninvasive indicator of therapy efficacy: pulse rate and SpO2 data displayed against the other therapy parameters

Therapy data management solutions

DirectView

Manage patient therapy data to adjust settings if necessary and help maintain treatment efficacy
- Enhance clinical evaluation
- Efficiently manage MI-E therapy
- Identify adjustments to maintain effective treatment
- Improve patient care

Internal memory and SD card records allow long-term follow-up

Waveform Trends Data

Internal memory

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vti/PCF</td>
<td>6 days</td>
</tr>
<tr>
<td>SpO2/HR</td>
<td>7 days (SpO2), 7 days (HR)</td>
</tr>
<tr>
<td>SD card</td>
<td>&gt; 1 year</td>
</tr>
</tbody>
</table>

Coughs per day
To get the values
More than a year of statistics
Summary
Settings and prescription history

Is my patient compliant?
1 year compliance data
and pattern of usage
(coughs per day)

How does patient's ability
to cough progress?
1 year long-term trends
(average peak cough flow and
Vt)
Daily trends (flow, pressure,
Vt, oximetry)

DirectView reports

– SpO2 and pulse rate data appear in the waveforms tab, along with flow, pressure and Vt

Phases of a normal cough cycle

Ideal flow waveforms

Cough cycle
Therapy data management use

Requirements for a comfortable and efficient mechanical in-exsufflation
- Give tools to clinician to verify efficiency of therapy of CoughAssist T70
  - Ability of CoughAssist T70 to measure and display data of inhale and exhale phases, short and long term
- Adapted to existing tools
  - Compatible with current data management software (DirectView 2.0)

Philips Respironics’ answer
- Instant display of PCF and VT during therapy
- Monitoring of SpO₂ and HR at rest – Standby mode
- Ability to hide data from patient (Detailed View OFF)
- Waveforms, trends and data recording for follow-up

Benefits for the clinicians
- Assess efficiency of therapy
  - during therapy
  - during follow-ups
- Unique oximetry cable but shared module and sensors
- Trends, waveform and data to be studied on same software as ventilation data

CoughAssist T70 MI-E device initial setup
- Install the power cord to receptacle on rear of CoughAssist T70
- Position device on a suitable surface
- Assemble the patient circuit
- Plug power cord into properly grounded outlet
- Attach patient circuit
Suggested treatment

- Therapy look-out
  - Cough cycle = Inhale + Exhale + Pause
  - Sequence = 4 to 6 cough cycles given in rapid succession
  - Resting time = patient rests for 20 to 30 seconds
  - During rest, clear secretions that are visible in the mouth, throat or tracheostomy tube
  - Therapy = repeat above sequence 3 to 6 times or until secretion is expelled

Example of settings

- Pressures (positive and negative)
  - Start low, 10 to 15 cm H₂O
  - Acclimate patient to device
  - Increase pressures as tolerated, 35 to 45 cm H₂O ideally
  - The goal of expiratory pressure is to replace a good expiratory cough flow
  - Possibility to use abdominal and chest compression during expiration (i.e., set with automatic mode or use foot pedal in Manual mode)
  - Higher pressures are often required when compliance decreases or resistance increases (small trach tubes, obesity, scoliosis)

Suggested settings

- Pressures (positive and negative)
  - Start low, 10 to 15 cm H₂O
  - Acclimate patient to device
  - Increase pressures as tolerated, 35 to 45 cm H₂O ideally
  - The goal of expiratory pressure is to replace a good expiratory cough flow
  - Higher pressures are often required when compliance decreases or resistance increases (small trach tubes, obesity, scoliosis)
  - Barotrauma is rare


Benefits of insufflation

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

Settings

- Important to work with patient to find settings which are both comfortable and effective
- Studies have shown that therapeutic PCF may not be reached with MI-E expiratory pressures less than -40 cm H2O

Suggested CoughAssist T70 MI-E treatment

\[ \text{Inhale} + \text{Exhale} + \text{Pause} \quad \text{= Cycle} \]

- Repeat cycle 4-6 times
- Rest 20-30 seconds
- Repeat sequence 4-6 times
Summary

- Used via facemask, mouthpiece, endotracheal or trach tube with pediatric and adult patients
- Maximal effectiveness at pressures of 40 to -40 cm H₂O
- Increase peak cough expiratory flows more than 80%¹
- Recommended use to reduce recurrent respiratory infections in patients with respiratory weakness from neuromuscular disease²
- Patients prefer MI-E to suctioning for comfort and effectiveness²

²Boitano, Louie, Mgmt of Airway clearance in NMD. Respiratory Care, August 2006.

In the literature

CoughAssist MI-E strategy: ventilator-dependent spinal cord injured patients

- Protocol established to include
  - Patient identification
  - Treatment plans
  - Treatment procedures

- Results
  - Low incidence of atelectasis
  - Increased functional residual capacity
  - VAP rate <1%
  - 97% weaning rate (excluding cervical injuries above C-4)
  - Successful decannulation rate
  - Patient preference for CoughAssist MI-E over suctioning

Effects of MI-E in preventing respiratory failure after extubation

• Objective
  – To assess the efficacy of MI-E as part of a protocol for patients who develop respiratory failure after extubation

• Method
  – Randomized control trial
  – 75 patients from a 12-bed ICU
  – Neuromuscular patients excluded
  – On vent for more than 48 hrs.
  – Successfully tolerated spontaneous breathing trial
  – Randomized into two groups
    • Control group – conventional extubation protocol
    • Study group – CoughAssist protocol

<table>
<thead>
<tr>
<th>Control group</th>
<th>Study group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>62 ± 19.2</td>
</tr>
<tr>
<td>Duration of MV</td>
<td>9.4 ± 4.8</td>
</tr>
<tr>
<td>Patients with chronic pulmonary disorders</td>
<td>9 (23%) 7 (20%)</td>
</tr>
<tr>
<td>Patients with hypoxemia resp. failure</td>
<td>24 (60%) 18 (52%)</td>
</tr>
</tbody>
</table>

Control group
Standard protocol
Oxygen PRN, CPT, bronchodilators, antibiotics, NIV if needed

Study group
CoughAssist MI-E protocol
Standard protocol plus
• MI-E (3 sessions) before extubation
• Inspiratory pressures = 40 cm H2O
• Expiratory pressures = - 40 cm H2O
• 48 hrs post extubation 3 daily treatments
Effects of MI-E in preventing respiratory failure after extubation

Results
- Study group has significantly lower re-intubation rates and lower time under mechanical ventilation (MV)
- Mean ICU stay post-extubation was significantly lower in study group

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Study group</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIV application (%)</td>
<td>20 (50%)</td>
<td>14 (40%)</td>
</tr>
<tr>
<td>Total period of MV (days)</td>
<td>17.8 ± 6.4</td>
<td>11.7 ± 3.5</td>
</tr>
<tr>
<td>Total ICU length of stay</td>
<td>19.3 ± 8.1</td>
<td>16.9 ± 11.1</td>
</tr>
<tr>
<td>Post-extubation ICU length of stay</td>
<td>9.8 ± 6.7</td>
<td>3.1 ± 2.5</td>
</tr>
</tbody>
</table>

Conclusion
- Inclusion of MI-E in post-extubation failure may reduce re-intubation rates with consequent reduction in post-extubation ICU stay
- Technique improves the efficacy of NIV in this population

CEU certificate
- To obtain your CEU certificate log on to the Philips Respironics’ Partners in Training website at: http://pit.respironics.com
- Log in to the website
- Click on “CEU Online Management System” on the left side