



Mechanical insufflation-exsufflation is a high risk procedure and may generate droplets exposing staff to respiratory pathogens. Appropriate Personal Protective Equipment (PPE) must be applied to reduce exposure to respiratory secretions.

POLICY STATEMENT

A physician order is required prior to initiating the mechanical insufflation-exsufflation (MI-E) device. The MI-E is an *alternative to traditional suctioning* providing decreased mucosal trauma and increased patient comfort. Principally, the MI-E is for patients who are unable to cough or clear secretions effectively due to reduced peak cough flow (less than 3 litres per second or 180 L/min) resulting from spinal cord injuries (SCI) and neuromuscular diseases such as ALS, Guillain-Barré Syndrome GBS, myasthenia gravis, muscular dystrophy, multiple sclerosis, post polio, kypho-scoliosis, and syringomyelia.

DEFINITIONS

Assisted Cough Manoeuvre:

A manually Assisted Cough Manoeuvre involves the application of an abdominal thrust or costal lateral compression using various hand placements after an adequate spontaneous inspiration or maximal insufflation.

FEF Max:

The maximum Forced Expiratory Flow rate (FEF) measured during a Force Vital Capacity (FVC) manoeuvre.

GPB: Glossopharyngeal Breathing (GPB) is a method of breathing, which consists of stroke-like action of the tongue along with constricting action of the pharynx pumping air through the larynx into the lungs.

LVR: Lung Volume Recruitment (LVR) refers to breath stacking, techniques allowing a maximum insufflation capacity.

MIC: The Maximum Insufflation Capacity (MIC) measurement (litres) is the maximum volume of air stacked within the patient's lungs beyond spontaneous vital capacity. MIC is attained when the patient takes a deep breath, holds his breath and then breath stacking is applied using a LVR resuscitation bag, a volume ventilator or glossopharyngeal breathing (GPB). When measuring a MIC, the therapist should assist the patient with his/her optimal insufflation technique, introduce the spirometer in the post mode and instruct the patient to completely exhale the MIC volume through the spirometer. *The documented volume must be clearly identified as a MIC and not a post bronchodilator study.*

MI-E: The Mechanical Insufflation-Exsufflation (MI-E) unit gradually applies a positive pressure to the airway, and then rapidly shifts to a negative pressure. This rapid shift in pressure produces a high expiratory flow rate from the lungs, simulating a cough.

MI-E may:

- recruit lung volumes;
- treat and prevent atelectasis;
- improve cough effectiveness;
- increase mechanical compliance;
- optimize thoracic range of motion;
- increase speaking volume.

PCF: Peak Cough Flow (PCF) is measured by using a peak flow meter. The PCF is the velocity of air being expelled from the lungs after a **cough** manoeuvre. This measurement can be expressed in L/min or L/sec (L/min divided by 60).

It is useful to measure:

- spontaneous PCF (PCF sp)
- PCF from MIC (PCF bag, PCF vent, or PCF gpb)
- PCF from MIC with an assisted cough timed with the cough (PCF bag & assist, PCF vent & assist or PCF gpb & assist)

The PCF correlates well with the actual FEF Max (L/sec) measurement commonly measured with the spirometer. Multiply your FEF value by 60 to obtain a PCF measurement in L/min.

CRITERIA

The patient must be **alert, cooperative with respiratory manoeuvres and able to communicate.**

CLINICAL INDICATIONS

- An established diagnosis as paralytic/restrictive disorder (refer to the Policy Statement section).
- Patient is unable to cough or clear secretions effectively with a PCF less than 180 L/min using LVR with bag, GPB or volume ventilator (& assisted cough manoeuvre when indicated).
- Patient is overly fatigued when performing LVR with the resuscitation bag, GPB or volume ventilator.

ABSOLUTE CONTRA-INDICATIONS

Supplemental oxygen should not be bled into the MI-E circuit. Oxygen will pass through the fan system during the exsufflation phase resulting in a potential fire hazard.

- Presence of haemoptysis, untreated or recent pneumothorax, bullous emphysema, nausea and emesis, severe COPD, severe asthma and recent lobectomy.
- Increased intra cranial pressure (ICP) including ventricular drains.
- Impaired consciousness / inability to communicate in instances where the patient does NOT have an artificial airway.

RELATIVE CONTRA-INDICATIONS

- therapy immediately following meals;
- tachypnea;
- history of COPD and pneumothorax;
- large pleural effusion;
- cervical spinal injury unclear;
- hemodynamic instability;
- impaired consciousness / inability to communicate where the patient has an artificial airway.

The use of the MI-E in patients with intrinsic lung diseases (such as chronic obstructive pulmonary disease (COPD), bronchiectasis, cystic fibrosis (CF), pulmonary fibrosis, and asthma) where secretions may be abundant should be introduced with caution and at times may not be indicated. The efficacy of the treatment in this instance must be monitored by a physician specialized in lung physiology such as a staff respirologist or intensivist.

The use of the MI-E in other conditions not specified in the policy should be discussed with the care team.

PRECAUTIONS

- Patients known to have cardiac instability should be monitored for arrhythmias (especially acute SCI), oximetry (SpO₂), dyspnea, vital signs & symptoms.
- Patients with a combination of intrinsic diseases and paralytic/restrictive disorders must be referred to a staff respirologist or intensivist for consultation (the MI-E may cause early closure in flaccid airways such as COPD, CF, bronchiectasis).
- Patients with long-standing thoracic cage restriction who may have severely reduced thoracic compliance will require slow incremental insufflations during the initial introductory period.
- Notify physician if chest pain is present.

EQUIPMENT

- appropriate PPE;
- MI-E apparatus;
- filter;
- connector with pressure port for the Emerson In-Exsufflator model 2-CMH;
- 5 foot (180 cm) disposable smooth bore tubing;
- 10 – six inch (15 cm,) flex tube with 15 mm connector for trached or intubated patients;
- transparent mask (preferred option);
- trach / endotracheal connector ;
- mouth piece and nose clip (optional) for exceptional circumstances;
- suction source on stand-by for patients with artificial airways and as clinically indicated for other patients (in-line suction where indicated in isolation cases).

PROCEDURE

The MI-E is best performed in the sitting or semi recumbent position however, can be done in supine. C-spine stabilization must be assessed and the head and neck must always be supported (appropriate brace or collar) if an assisted cough manoeuvre is performed in coordination with the exsufflation phase.

MI-E sessions are usually performed:

- QID, and prn, to a maximum of Q10 minutes to avoid hyperventilation;
- ideally in the morning *upon awakening*, before meals and at bedtime;
- with assisted cough BID and PRN when indicated.

The MI-E can be applied via mask, tracheostomy or endotracheal tube.

PRE THERAPY ASSESSMENT

- perform a general respiratory assessment / confirm pulmonary restriction / exclude significant obstructive disease;
- baseline spirometry and spirometry with the LVR bag;
- SpO₂, pulse rate;
- optional: MIP / MEP and for non intubated patients PCF sp & PCF with LVR & PCF with LVR & assisted cough manoeuvre where applicable.

In an emergency, perform modified respiratory assessment, and monitor the SpO₂ and pulse rate. Other objective measures should be performed at the first available opportunity when the circumstance is no longer urgent.

NOTE

- Initial suggested pressures should be set 5-10 cmH₂O above the patients maximum MIP (to minimize the over stretching of the chest wall soft tissues and muscles). Gradually increase the pressures over the first 48 to 72 hours by 5-10 cmH₂O until the ordered level is reached. In an acute condition, the pressure should be increased within a few sessions however, in emergent situations, utilize minimal effective pressure of +/-30 cmH₂O from the onset (unless otherwise prescribed by physician).
- Minimal effective pressures are +/- 30 cmH₂O and the most common therapeutic range is +/- 40 to 50 cm H₂O.
- The exufflation pressure (absolute number) should never be less than the insufflation pressure.
- When initiating the MI-E it is important to maintain LVR with the bag on a daily basis, minimum twice a day, (AM & PM) and PRN thereafter. This ensures the patient will be able to resume LVR with the bag once the MI-E is discontinued.
- Patients requiring supplemental oxygen can be oxygenated with the resuscitation bag between MI-E treatments.

EMERSON COUGHASSIST Model 3000

To view the new model visit - <http://www.rehab.on.ca/irrd/education/slide.asp?slideid=1>

1. Assemble the necessary equipment.
2. Introduce the therapy and the procedure to the patient.
3. Press power ON.
4. Turn the *Inhale Pressure Control Knob (top right)* clockwise to maximum position. (varies the aspiratory pressure between 50-100% of the exhale pressure).
5. Set the initial insufflation/exsufflation pressure by occluding the end of the circuit with your gloved thumb while holding the *Manual Control Lever* in the inhale/exhale for a minimum of 2 seconds for each position. At the same time adjust the *Pressure Adjustment Knob (left of Manual Control Lever)* to the desired prescribed pressure while watching the manometer on the display panel. Release the Manual Control Lever to ensure the pressure returns to 0 cmH₂O.

Remark: Unequal pressures such as + 30, - 35 cmH₂O may be prescribed to maximize the exsufflation phase while minimizing the stretch to the intercostals muscles during the insufflation phase. Turn the *Inhale Pressure Control Knob (top right)* to decrease the inhalation pressure.

Always verify pressure settings before starting each treatment!

6. Apply the face mask interface securely and adjust to eliminate leak.
7. Coordinate therapy with patient breathing pattern.
8. Slide the *Manual Control Lever* to the (+) as the patient is breathing in. Hold for 3 seconds and vocalize IN-ONE THOUSAND, TWO-ONE THOUSAND, and THREE-ONE THOUSAND.
9. Rapidly slide the *Manual Control Lever* from the (+) to the (-). Hold for 2-3 seconds and vocalize COUGH ONE-THOUSAND, TWO-ONE THOUSAND (and THREE-ONE THOUSAND). An assisted cough manoeuvre may be added where indicated at the onset of the COUGH command.

Remember to rapidly shift the lever from (+) to the (-). This sudden change promotes the greatest pressure gradient and a maximum expiratory flow.

10. Repeat the inhale/exhale cycle 3-5 times.
11. Remove the face mask while maintaining the (-) pressure to clear the secretions from the airway.
12. Rest 30 seconds to avoid hyperventilation between treatments.
13. One treatment is equal to 3-5 cycles and one session is equal to 3-5 treatments.
14. Suction should be on standby if clinically indicated. Suctioning beyond the tracheostomy and endotracheal tube is rarely indicated.
15. Assess treatment efficacy including weekly spirometry to assess PCF.

EMERSON IN-EXSUFFLATOR Model 2-CMH

To view the older model - <http://www.rehab.on.ca/irrd/education/slide.asp?slideid=20>

1. Assemble the necessary equipment.
2. Introduce the therapy and the procedure to the patient.
3. Close off both inhale and exhale pressure adjustment knobs (bottom left) by turning them fully clockwise.
4. Press power switch ON.
5. Set the initial insufflation/exsufflation pressure by adjusting the maximum pressure/suction knob. Verify your pressure setting by occluding the end of the circuit with your gloved thumb and sliding the chrome elbow to inhale and exhale for a minimum of 2 seconds for each position. Repeat until you have the desired pressure.
Remark: Unequal pressures such as + 30, - 35 cmH₂O may be prescribed to maximize the exsufflation phase while minimizing the stretch to the soft tissues and intercostals muscles during the insufflation phase. The exufflation pressure (absolute number) should never be less than the insufflation pressure. Adjust your pressures as above to the highest pressure reading then introduce a leak by turning the inhale pressure adjustment knob (bottom-middle of unit) to the desired reduce inhale pressure. Verify your pressure setting as above.

Always verify pressure settings before starting each treatment!

6. Apply the face mask interface securely and adjust to eliminate leak.
7. Coordinate therapy with patients breathing pattern.
8. Slide the chrome elbow to (+) as patient is breathing in. Hold for 2-3 seconds and vocalize IN-ONE THOUSAND, TWO-ONE THOUSAND (and THREE-ONE THOUSAND).
9. Rapidly slide the chrome elbow from the (+) to the (-). Hold for 3 seconds and vocalize COUGH-ONE THOUSAND, TWO-ONE THOUSAND, and THREE-ONE THOUSAND. An assisted cough manoeuvre may be added where indicated at the onset of the COUGH command.

Remember to rapidly shift the chrome elbow from (+) to the (-). This sudden change promotes the greatest pressure gradient and a maximum expiratory flow.

10. Repeat the inhale/exhale cycle 3-5 times.
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13. One treatment is equal to 3-5 cycles and one session is equal to 3-5 treatments.
14. Suction should be on standby if clinically indicated. Suctioning beyond the tracheostomy and endotracheal tube is rarely indicated.
15. Assess treatment efficacy including weekly spirometry to assess PCF.

WEANING

- The MI-E may be discontinued if LVR with the bag is effective, achieving a PCF greater than 180 L/min and achieving airway clearance (refer to Documentation section).
- The patient is not overly fatigued when performing lung secretion clearance with the bag.
- A physician order is required to discontinue the MI-E.

HELPFUL HINTS

- The insufflation / exsufflation pressure are usually the same unless one wishes to minimize the stretch to the intercostals muscles.
- A jaw thrust may be required to maintain airway patency in patients with significant bulbar muscle weakness.
- MI-E with trachs and endotracheal tubes
 - Connectors must have a snug fit.
 - May require higher pressures due to the narrowing of artificial airway.
 - Best to have trach with cuff inflated to allow for inxsufflation via trach.
 - For cuffless trachs, cork the trach and use the MI-E via mask/mouth. A tight stoma is required and if the stoma is not tight you should consider having the trach changed to a cuffed trach tube.
 - Inxsufflation may be achieved via the trach site with a cuffless trach however, the patient must have excellent control of the upper airway.
 - Discard the six inch tube with 15 mm connector after each use when sputum present.

DOCUMENTATION

Clinical documentation includes:

- Physician order: E.g. spirometry (FVC, FEV1, FEF & MIC, FEF with LVR)
E.g. MI-E, Q4H while awake and PRN
+/- 40 cmH20, may increase pressures gradually;
- General respiratory assessment noting
 - Clinical indications, contra-indications and precautions;
- Initial MI-E treatment
 - Pre MI-E therapy
 - Chest assessment, FVC, FEV1, FEF & MIC, FEF with LVR (by spirometry for non intubated patients only) SpO₂, pulse rate & MIP/MEP if all possible
 - Optional: for non intubated patients PCF sp & PCF with LVR & PCF with LVR & assisted cough manoeuvre;
 - Introduce MI-E gently
 - Post therapy
 - Treatment efficacy, relief of dyspnea and congestion, chest excursion, sputum consistency, volume, color and patient compliance, tolerance to therapy and treatment plan;
- Subsequent therapy
 - Treatment efficacy and SpO₂ and pulse rate if necessary;

- Weekly, measure the PCF bag (& assist if indicated) to assess if patient is able to resume LVR with bag.

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