

Incentive Spirometry: 2011

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We searched the MEDLINE, CINAHL, and Cochrane Library databases for articles published between January 1995 and April 2011. The update of this clinical practice guideline is the result of reviewing a total of 54 clinical trials and systematic reviews on incentive spirometry. The following recommendations are made following the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) scoring system. **1: Incentive spirometry alone is not recommended for routine use in the preoperative and postoperative setting to prevent postoperative pulmonary complications. 2: It is recommended that incentive spirometry be used with deep breathing techniques, directed coughing, early mobilization, and optimal analgesia to prevent postoperative pulmonary complications. 3: It is suggested that deep breathing exercises provide the same benefit as incentive spirometry in the preoperative and postoperative setting to prevent postoperative pulmonary complications. 4: Routine use of incentive spirometry to prevent atelectasis in patients after upper-abdominal surgery is not recommended. 5: Routine use of incentive spirometry to prevent atelectasis after coronary artery bypass graft surgery is not recommended. 6: It is suggested that a volume-oriented device be selected as an incentive spirometry device.** *Key words: breathing exercises, incentive spirometry, postoperative pulmonary complications, respiratory physiotherapy.* [Respir Care 2011;56(10):1600–1604. © 2011 Daedalus Enterprises]

IS 1.0 DESCRIPTION/DEFINITION

Postoperative pulmonary complications are reported in the range of 2–39%,^{1,2} and include atelectasis, pneumonia, and respiratory failure. Upper-abdominal surgical procedures are associated with a higher risk of complications, followed by lower-abdominal surgery and thoracic surgery. Preoperative and postoperative respiratory therapy aims to prevent or reverse atelectasis and improve airway

clearance.³ The risk and severity of complications can be reduced by the use of therapeutic maneuvers that increase lung volume. Incentive spirometry has been routinely considered a part of the perioperative respiratory therapy strategies to prevent or treat complications. Incentive spirometry is designed to mimic natural sighing or yawning by encouraging the patient to take long, slow, deep breaths. This decreases pleural pressure, promoting increased lung expansion and better gas exchange. When the procedure is repeated on a regular basis, atelectasis may be prevented or reversed.^{4–6} Expiratory maneuvers such as positive expiratory pressure (PEP) and vibratory PEP do not mimic the sigh. While incentive spirometry is widely used clinically as a part of routine prophylactic and therapeutic regimen in perioperative respiratory therapy, its clinical efficacy remains controversial.⁷

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IS 2.0 PROCEDURE

Incentive spirometry, also referred to as sustained maximal inspiration, is accomplished by using a device that provides feedback when the patient inhales at a predetermined flow or volume and sustains the inflation for at least

5 seconds. The patient is instructed to hold the spirometer in an upright position, exhale normally, and then place the lips tightly around the mouthpiece. The next step is a slow inhalation to raise the ball (flow-oriented) or the piston/plate (volume-oriented) in the chamber to the set target. At maximum inhalation, the mouthpiece is removed, followed by a breath-hold and normal exhalation. Instruction of parents, guardians, and other health caregivers in the technique of incentive spirometry may help to facilitate the patient's appropriate use of the technique and assist with encouraging adherence to therapy.

IS 3.0 LIMITATIONS OF METHOD

The usefulness of prophylactic respiratory therapy, including incentive spirometry, for the prevention of clinically relevant postoperative pulmonary complications is controversial.

3.1 The effectiveness of incentive spirometry may depend on patient selection, careful instruction, and supervision during respiratory training.

3.1.1 Inadequate training and insufficient self-administration of incentive spirometry may result in lack of resolution of postoperative complications.⁸

3.2 Evidence strongly suggests that incentive spirometry alone may be inappropriate to prevent or treat postoperative complications.⁹⁻¹¹

3.3 Respiratory therapy, with or without incentive spirometry, may have similar clinical outcomes.

3.3.1 Preoperative and postoperative respiratory therapy that includes deep breathing exercises, directed cough, early mobilization, and optimal analgesia,¹²⁻¹⁴ with or without incentive spirometry, appears to be effective in preventing or reversing complications after thoracic surgery,¹⁵⁻¹⁹ cardiac surgery,²⁰⁻²² abdominal surgery,²³⁻²⁹ and peripheral surgery in obese adults.³⁰

3.3.2 Evidence is lacking for benefit of incentive spirometry in reducing pulmonary complications and in decreasing the negative effects on pulmonary function in patients undergoing coronary artery bypass graft surgery.^{29,31-34}

3.3.3 Incentive spirometry has not been associated with significant improvements of inspiratory capacity prior to laparoscopic bariatric surgery and may not be useful to prevent postoperative decrease in lung function.^{35,36}

3.3.4 There is no significant difference between deep breathing with directed cough and incentive spirometry in the prevention of postoperative pulmonary complications following esophagectomy.³⁷

3.3.5 In patients with neuromuscular disease, incentive spirometry may not be as effective as

intrapulmonary percussion ventilation in preventing atelectasis.³⁸

IS 4.0 SETTINGS

4.1 Critical care

4.2 Acute care in-patient

4.3 Extended care and skilled nursing facility

4.4 Home care

IS 5.0 INDICATIONS

5.1 Preoperative screening of patients at risk for postoperative complications to obtain baseline flow or volume.^{16,39,40}

5.2 Respiratory therapy that includes daily sessions of incentive spirometry plus deep breathing exercises, directed coughing, early ambulation, and optimal analgesia may lower the incidence of postoperative pulmonary complications.

5.3 Presence of pulmonary atelectasis or conditions predisposing to the development of pulmonary atelectasis when used with:

5.3.1 Upper-abdominal or thoracic surgery⁶

5.3.2 Lower-abdominal surgery⁴¹

5.3.3 Prolonged bed rest

5.3.4 Surgery in patients with COPD

5.3.5 Lack of pain control⁴²

5.3.6 Presence of thoracic or abdominal binders

5.3.7 Restrictive lung defect associated with a dysfunctional diaphragm or involving the respiratory musculature

5.3.7.1 Patients with inspiratory capacity < 2.5 L⁴³

5.3.7.2 Patients with neuromuscular disease

5.3.7.3 Patients with spinal cord injury⁴⁴

5.4 Incentive spirometry may prevent atelectasis associated with the acute chest syndrome in patients with sickle cell disease.^{42,45}

5.5 In patients undergoing coronary artery bypass graft⁴⁶

5.5.1 Incentive spirometry and positive airway pressure therapy may improve pulmonary function and 6-minute walk distance and reduce the incidence of postoperative complications.^{47,48}

IS 6.0 CONTRAINDICATIONS

6.1 Patients who cannot be instructed or supervised to assure appropriate use of the device

6.2 Patients in whom cooperation is absent or patients unable to understand or demonstrate proper use of the device

- 6.2.1 Very young patients and others with developmental delays
- 6.2.2 Patients who are confused or delirious
- 6.2.3 Patients who are heavily sedated or comatose
- 6.4 Incentive spirometry is contraindicated in patients unable to deep breathe effectively due to pain, diaphragmatic dysfunction, or opiate analgesia.⁵
- 6.5 Patients unable to generate adequate inspiration with a vital capacity < 10 mL/kg or an inspiratory capacity < 33% of predicted normal.⁵

IS 7.0 HAZARDS AND COMPLICATIONS

- 7.1 Ineffective unless performed as instructed
- 7.2 Hyperventilation/respiratory alkalosis
- 7.3 Hypoxemia secondary to interruption of prescribed oxygen therapy
- 7.4 Fatigue
- 7.5 Pain

IS 8.0 ASSESSMENT OF NEED

- 8.1 Surgical procedure involving abdomen or thorax
- 8.2 Conditions predisposing to development of atelectasis, including immobility and abdominal binders

IS 9.0 ASSESSMENT OF OUTCOME

- 9.1 Resolution or improvement in signs of atelectasis
 - 9.1.1 Decreased respiratory rate
 - 9.1.2 Absence of fever
 - 9.1.3 Normal pulse rate
 - 9.1.4 Improvement in previously absent or diminished breath sounds
 - 9.1.5 Improved radiographic findings
 - 9.1.6 Improved arterial oxygenation (P_{aO_2} , S_{aO_2} , S_{pO_2}), reduced F_{IO_2} requirement

IS 10.0 RESOURCES

- 10.1 Equipment
 - 10.1.1 Volume-oriented incentive spirometer
 - 10.1.1.1 Volume-oriented incentive spirometers are frequently associated with lower imposed work of breathing and larger inspiratory lung volume than flow-oriented incentive spirometers.^{43,49-52}
 - 10.1.1.2 Incentive spirometers with a low additional imposed work of breathing might be more suitable for postoperative respiratory training.⁴³
 - 10.1.2 Flow-oriented incentive spirometer
- 10.2 Personnel
 - 10.2.1 Clinical personnel should possess:

- 10.2.1.1 Ability to implement standard/universal precautions
- 10.2.1.2 Mastery of techniques for proper operation and clinical application of device
- 10.2.1.3 Ability to instruct patient in proper technique
- 10.2.1.4 Ability to respond appropriately to adverse effects
- 10.2.1.5 Ability to identify need for therapy, response to therapy, and need to discontinue ineffective therapy

IS 11.0 MONITORING

Direct supervision of every patient use of incentive spirometry is not necessary once the patient has demonstrated mastery of technique. However, intermittent reassessment is essential to optimal performance.

- 11.1 Observation of patient performance and utilization
 - 11.1.1 Frequency of sessions
 - 11.1.2 Number of breaths/session
 - 11.1.3 Inspiratory volume, flow, and breath-hold goals achieved
 - 11.1.4 Effort/motivation
- 11.2 Device within reach of patient to encourage performing without supervision

IS 12.0 FREQUENCY

Evidence is lacking for a specific frequency for use of incentive spirometry. Some suggestions have been made in clinical trials.

- 12.1 Ten breaths every one⁵³ to two⁴² hours while awake
 - 12.2 Ten breaths, 5 times a day³⁴
 - 12.3 Fifteen breaths every 4 hours³⁶
- After proper instruction and return demonstration, the patient should be encouraged to perform incentive spirometry independently.

IS 13.0 INFECTION CONTROL

- 13.1 Centers for Disease Control guidelines for standard precautions should be followed.
- 13.2 All equipment and supplies should be appropriately disposed of or disinfected according to manufacturer recommendations.

IS 14.0 RECOMMENDATIONS

The following recommendations are made following the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) scoring system⁵⁴:

14.1 Incentive spirometry alone is not recommended for routine use in the preoperative and postoperative setting to prevent postoperative pulmonary complications (1B).

14.2 It is recommended that incentive spirometry be used with deep breathing techniques, directed coughing, early mobilization, and optimal analgesia to prevent postoperative pulmonary complications (1A).

14.3 It is suggested that deep breathing exercises provide the same benefit as incentive spirometry in the preoperative and postoperative setting to prevent postoperative complications (2C).

14.4 Routine use of incentive spirometry to prevent atelectasis in patients after upper-abdominal surgery is not recommended (1B).

14.5 Routine use of incentive spirometry to prevent atelectasis after coronary artery bypass graft surgery is not recommended (1A).

14.6 It is suggested that a volume-oriented device be selected as an incentive spirometry device (2B).

IS 15.0 CLINICAL PRACTICE GUIDELINE IDENTIFYING INFORMATION AND AVAILABILITY

15.1 Adaptation:

Original publication: *Respir Care* 1991;36(12):1402–1405.

15.2 Guideline Developers:

American Association for Respiratory Care Clinical Practice Guidelines Steering Committee

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No conflicts of interest

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