

ELSEVIER Clinical Skills

Mechanical Ventilation: Weaning Process (Respiratory Therapy)

ALERT

The weaning process may be taxing for some patients. Ensure that the patient does not become exhausted or develop signs of respiratory compromise. If at any time the patient exhibits signs or symptoms that suggest intolerance to the process, discontinue weaning and place him or her back on ventilator support.

Assess the patient's level of sedation before weaning. Sedation impedes the weaning process and increases the length of time spent receiving mechanical ventilation.

OVERVIEW

Weaning is defined as a progressive decline in the amount of ventilatory support that a patient receives from a ventilator. The weaning process includes decreasing ventilator support, assessing the patient's response, and possibly extubating the patient. The purpose of the weaning process is to liberate patients from mechanical ventilation. Removing the artificial airway is a desirable outcome of the weaning process but is not essential for liberation from ventilatory support. Knowledge and skills related to the care of patients on mechanical ventilation (e.g., airway management, suctioning, mechanical ventilator modes, blood gas analysis interpretation) are necessary for implementing the weaning process.

Weaning is successful when the patient's pulmonary system has the ability and capacity to perform the necessary work of spontaneous breathing. Both respiratory and nonrespiratory factors contribute to weaning success. The patient's oxygenation status before and during weaning is a strong indicator of success or failure. Cardiovascular function and psychological factors should be optimized for successful weaning from ventilatory support.

Weaning Assessment

Weaning readiness is determined by assessment of the patient's stability, resolution of the reason for mechanical ventilation, and achievement of selected weaning criteria goals (e.g., weaning indices) ([Box 1](#)) ([Box 2](#)).

Box 1 Standard Weaning Criteria

Negative inspiratory pressure ≤ -20 to -30 cm H₂O

Spontaneous tidal volume >5 ml/kg

Vital capacity $>10-15$ ml/kg

Fraction of inspired oxygen $\leq 40\%-50\%$

Minute ventilation <10 L/min

Positive end-expiratory pressure $<5-8$ cm H₂O

(From Kacmarek, R.M., Stoller, J.K., Heuer, A.J. [Eds.]. [2017]. *Egan's fundamentals of respiratory care* [11th ed.]. St. Louis: Elsevier.)

Box 2 Rapid Shallow Breathing (f/V_T)

Spontaneous respiratory frequency in 1 min = f

Tidal volume in liters = V_T

$f/V_T < 105$ = weaning success

$f/V_T > 105$ = weaning failure

f , frequency; V_T , tidal volume.

(From Gupta, P. and others. [2014]. The effect of a mechanical ventilation discontinuation protocol in patients with simple and difficult weaning: Impact on clinical outcomes. *Respiratory Care*, 59[2], 170-177.)

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Attention to other clinical factors is also important before initiating weaning trials.² Clinical tools and checklists ensure systematic attention to these factors and may help ensure good outcomes (Box 3). In addition, prophylaxis regimens are recommended to prevent complications in patients who are being mechanically ventilated. Complications include ventilator-associated pneumonia (VAP), deep vein thrombosis, gastrointestinal bleeding, and sinusitis.²

Box 3 Burns Weaning Assessment Program (BWAP)*			
Patient name _____			
Patient history number _____			
Yes	No	Not Assessed	General Assessment
___	___	___	1. Hemodynamically stable (pulse rate, cardiac output)?
___	___	___	2. Free from factors that increase or decrease metabolic rate (seizures, temperature, sepsis, bacteremia, hypothyroid, hyperthyroid)?
___	___	___	3. Hematocrit >25% (or baseline)?
___	___	___	4. Systemically hydrated (weight at or near baseline, balanced intake and output)?
___	___	___	5. Nourished (albumin >2.5, parenteral/enteral feedings maximized)? (If albumin is low and anasarca or third spacing is present, score for hydration should be "No.")
___	___	___	6. Electrolytes within normal limits (including Ca, Mg ⁺ , PO ₄)? Correct Ca for albumin level?
___	___	___	7. Pain controlled? (subjective determination)
___	___	___	8. Adequate sleep and rest? (subjective determination)
___	___	___	9. Appropriate level of anxiety and nervousness? (subjective determination)
___	___	___	10. Absence of bowel problems (diarrhea, constipation, ileus)?
___	___	___	11. Improved general body strength and endurance (e.g., out of bed in chair, progressive activity program)?
___	___	___	12. Chest roentgenogram improving?
Respiratory Assessment			
Gas Flow and Work of Breathing			
___	___	___	13. Eupneic respiratory rate and pattern (spontaneous respiratory rate <25 breaths/min, without dyspnea, absence of accessory muscle use). This is assessed off the ventilator while measuring #20-#23, below.
___	___	___	14. Absence of adventitious breath sounds (rhonchi, crackles, wheezing)?
___	___	___	15. Secretions thin and minimal?
___	___	___	16. Absence of neuromuscular disease or deformity?
___	___	___	17. Absence of abdominal distention, obesity, and ascites?
___	___	___	18. Oral endotracheal tube >7.5 Fr or tracheostomy >6.0 Fr
Airway Clearance			
___	___	___	19. Cough and swallow reflexes adequate?

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			Strength
___	___	___	20. Negative inspiratory pressure <-20 cm H ₂ O?
___	___	___	21. Positive end-expiratory pressure >+30 cm H ₂ O?
			Endurance
___	___	___	22. Spontaneous tidal volume >5 ml/kg?
___	___	___	23. Vital capacity >10-15 ml/kg?
			Arterial Blood Gases
___	___	___	24. pH 7.30-7.45?
___	___	___	25. PaCO ₂ approximately 40 mm Hg (or baseline) with minute ventilation <10 L/min (evaluated while on ventilator)?
___	___	___	26. PaO ₂ 60 mm Hg or FIO ₂ <40%?

*To score the BWAP: divide the number of "Yes" responses by 26.

Ca, calcium; FIO₂, fraction of inspired oxygen; Mg⁺, magnesium; PaCO₂, arterial partial pressure of carbon dioxide; PaO₂, arterial partial pressure of oxygen; PO₄, phosphate.

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The respiratory therapist (RT) remains with the patient, especially at the beginning of the trial; makes assessments frequently during the trial; coaches the patient; reinforces the goals and desired outcomes; and reminds the patient that successful weaning and extubation facilitate talking, eating, self-care activities, and mobilization.²

Weaning indices have proven to be disappointing predictors of a patient's ability to wean.² Most predictors focus on pulmonary-specific factors. In general, the indices are poor positive predictors (they do not indicate that the patient *will* wean), but they are good negative predictors (they indicate that the patient will *not* wean). Thus, use of the indices is not widespread. The various weaning indices are best used to evaluate the components from which they are designed (breathing pattern, respiratory muscle strength, etc.). These indices, if measured, are generally measured by the RT.

The patient's overall status should be optimized before weaning of the ventilatory support is attempted. In addition to respiratory condition, assessment of weaning readiness should include acid-base status, electrolyte balance, status of other organ systems, nutritional status, and psychological state.

Signs of Intolerance or Failure

During weaning, the patient should be continuously monitored for respiratory distress. No single symptom defines failure. Patients should be monitored for:

- Increased work of breathing (nasal flaring, use of accessory muscles, paradoxical chest movements, retractions)
- Crackles or wheezing on auscultation
- Oxygen saturation
- Changes in mental status
- Blood pressure
- Heart rate
- Cardiac arrhythmias
- Respiratory rate
- Tidal volume (V_T)
- Minute volume (MV)

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- Change in end-tidal carbon dioxide (ETCO₂) level

Weaning Trial Protocols

Protocol-directed spontaneous breathing trials (SBTs) can reduce ventilator duration. When combined with aggressive sedation management, they may also reduce intensive care unit length of stay, hospital length of stay, and mortality. Protocol-directed multidisciplinary weaning using weaning screens and short-duration SBTs are superior to individualized weaning processes,² although acceptance of and adherence to protocols may be low. The use of the protocols decreases practice variation, which may be the major reason for their effectiveness. Key to a protocol's success is the use of the weaning screen, which requires that a minimum of clinical factor thresholds (e.g., hemodynamic stability, fraction of inspired oxygen [FIO₂], and positive end-expiratory pressure [PEEP] level) are met.² Screening ensures early and aggressive testing of the patient's readiness. Once the screen is passed, the patient is placed on an SBT for a short duration before extubation. If signs of intolerance emerge, the patient is returned to ventilatory support and a trial is reattempted at a later time as predetermined by the protocol.

Methods for Weaning

SBTs appear to be the best method;² most of these methods employ breathing through a T-piece or on the ventilator (with or without the addition of continuous positive airway pressure [CPAP], low respiratory rates on synchronized intermittent mechanical ventilation [SIMV], or other flow mechanisms, such as automatic tube compensation). Other modes, such as pressure-support ventilation (PSV), may be equally as effective.

Respiratory Muscle Fatigue, Work, Rest, and Conditioning

During the weaning process, prevention of respiratory muscle fatigue must be considered. All muscles may fatigue if work exceeds energy stores. Signs and symptoms of impending fatigue include dyspnea, tachypnea, chest-abdominal asynchrony, and increasing arterial partial pressure of carbon dioxide (PaCO₂), which is a late sign. Generally, avoiding premature or excessively long or difficult weaning trials can prevent fatigue.

The concepts of work, rest, and conditioning are useful to consider when selecting weaning modes and methods. A higher respiratory workload is similar to strength training, and low-pressure, high-volume work is similar to endurance conditioning. These two methods of muscle conditioning apply to the respiratory muscles as well as other muscle groups within the body:

1. A higher respiratory workload is associated with the use of a T-piece and CPAP, with low intermittent mandatory ventilation (IMV) rates. Generally, any method that requires the patient to breathe spontaneously (without inspiratory support) results in high-pressure, low-volume work. Conditioning episodes are generally of short duration, with full muscle rest between episodes.
2. Low-pressure, high-volume work is found with the use of PSV, in which inspiration is augmented. For any given pressure level, workload is less than if the patient were breathing spontaneously. At high levels of PSV, little work occurs, but as the level is reduced, muscle workload increases.

With both types of conditioning, the goal is to progress through the trials without inducing fatigue. To that end, rest is that level of ventilatory support that unloads the respiratory

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muscles. The level of support needed may differ with each patient; however, two basic concepts may be useful:

1. When signs of intolerance emerge, the trial is stopped and the patient is rested.
2. Application of rest varies with the weaning mode. For example, if the mode is PSV, then the PSV is increased to the level required to decrease the spontaneous rate to a respiratory rate within a normal range and the result is a synchronous, comfortable breathing pattern. With high-pressure, low-volume modes such as CPAP, the patient is returned to full ventilatory support.

Multidisciplinary Approaches

A plan for weaning is determined by the multidisciplinary team and is applied and monitored carefully. The plan, whether it employs a protocol or consists of a more individualized plan, should be available to all health care professionals involved in the weaning process. Assessment of weaning potential may include checklists of factors important to weaning, such as the Burns Weaning Assessment Program ([Box 3](#)). In addition, prophylaxis for VAP and other potential complications associated with mechanical ventilation must be considered.

EDUCATION

- Explain the steps of weaning and why weaning is being initiated.
- Reassure the patient of the RT's presence during initiation of weaning.
- Discuss the sensations the patient may experience, such as smaller ventilator-assisted breaths, dyspnea, and change or absence of ventilator sounds; explain that weaning trials are a form of conditioning and do require effort. Some dyspnea is to be expected.
- Encourage the patient to relax and breathe comfortably.
- Assure the patient and family that rapid return to ventilatory support will be accomplished if the patient becomes excessively dyspneic, becomes anxious, or exhibits negative physiologic changes (e.g., desaturation; blood pressure or heart rate or rhythm changes; diaphoresis).
- Encourage questions and answer them as they arise.

ASSESSMENT AND PREPARATION

Assessment

1. Perform hand hygiene before patient contact.
2. Introduce yourself to the patient.
3. Verify the correct patient using two identifiers.
4. Regularly evaluate factors that impede weaning in conjunction with factors that measure respiratory muscle strength, endurance, and gas exchange ([Box 1](#)) ([Box 2](#)) ([Box 3](#)).
5. Frequently assess the patient's progress toward achievement of individual short-term goals.
6. In patients who require mechanical ventilation for very long times (and may require a tracheostomy), assess daily progress toward achievement of individual long-term goals in collaboration with the practitioner, nurse, patient, and family, as appropriate.
7. Assess changes in level of consciousness or nonverbal behavior and complaints of dyspnea or fatigue.
8. Assess arterial blood gas (ABG) values as needed.
9. Assess partial pressure of ETCO₂ levels.

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10. Assess oxygenation indices (arterial oxygen saturation [SaO_2] or arterial partial pressure of oxygen [PaO_2]) during trials.
11. Assess the patient's anxiety level.
12. Evaluate the patient's stability and overall condition before initiating active weaning trials.

Rationale: Premature weaning attempts may be harmful and frustrating for all involved. A multidisciplinary team approach ensures active attention to the diverse factors that affect weaning readiness ([Box 1](#)) ([Box 2](#)) ([Box 3](#)).

Preparation

1. Ensure that the patient understands preprocedural weaning instruction.
2. Address all factors that may impede weaning potential.
 - a. Factors include pH level, hemodynamic stability, electrolytes, strength, endurance, mobility, nutrition, and fluid status.
 - b. A systematic approach using a checklist helps avoid variation in practice.
3. Establish weaning screen criteria, if applicable.
4. Determine the duration of the weaning trial before beginning.

PROCEDURE

T-Piece or Tracheostomy Collar Trials

1. Perform hand hygiene and don gloves. For patients with isolation precautions, also don a gown, mask, and eye protection.
2. Verify the correct patient using two identifiers.
3. Explain the procedure to the patient and ensure that he or she agrees to treatment.
4. Position the patient for optimum ventilation. Positions for optimum ventilation vary, but most patients should be positioned with the head of the bed elevated 30 degrees or higher.¹
5. Communicate with the patient and family throughout the weaning process.
6. Suction the artificial airway to ensure patency.
7. Connect the patient to a heated aerosol via a T-piece or tracheostomy collar.

Rationale: Heated aerosol replaces water, which normally is added by the upper airway when it is not bypassed by an endotracheal or a tracheostomy tube.

8. Inform the patient that the trial will feel different than when on the ventilator and instruct him or her to try to breathe normally.
9. Monitor the patient's respiratory frequency, breathing pattern, heart rate and rhythm, SaO_2 , and general appearance.

Rationale: Signs and symptoms of tolerance must be heeded to prevent respiratory muscle fatigue.

Closely tend to the patient because the T-piece and tracheostomy collar have no alarms for apnea or hypoventilation.

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10. After a predetermined time interval or with the emergence of signs of intolerance, place the patient back on resting ventilator settings.

Do not exceed the predetermined duration of the weaning trial.

Rationale: Adequate rest between trials and at night offsets fatigue and encourages effective respiratory muscle conditioning. The patient is placed back on the ventilator to rest until all data regarding weaning response can be assessed.

11. If the patient successfully meets full trial criteria, notify the practitioner and team regarding the patient's response, and consider extubation. If a protocol is in place, extubation may be the next step and may not require such notification.
12. Discard supplies, remove personal protective equipment (PPE), and perform hand hygiene.
13. Document the procedure in the patient's record.

CPAP Trials

1. Perform hand hygiene and don gloves. For patients with isolation precautions, also don a gown, mask, and eye protection.
2. Verify the correct patient using two identifiers.
3. Explain the procedure to the patient and ensure that he or she agrees to treatment.
4. Position the patient for optimum ventilation. Positions for optimum ventilation vary, but most patients should be positioned with the head of the bed elevated 30 degrees or higher.¹
5. Communicate with the patient and family throughout the weaning process.
6. Suction the artificial airway to ensure patency.
7. Change the patient from resting ventilatory settings to CPAP.

Rationale: An advantage of CPAP over T-piece trials is that VT and respiratory rate are monitored easily throughout the trial by the ventilator. The RT can set alarms with a CPAP trial.

8. Instruct the patient to breathe normally and monitor for signs and symptoms of intolerance. If using a protocol, refer to specific criteria.

Rationale: As with the T-piece, this method employs high-pressure, low-volume work. Prompt return to the ventilator is necessary to prevent excessive work and fatigue.

9. After a predetermined time interval on CPAP or with signs or symptoms of intolerance, place the patient back on resting ventilator settings.

Do not exceed the predetermined duration of the weaning trial.

Rationale: Adequate rest between trials and at night offsets fatigue and encourages effective respiratory muscle conditioning. The patient is placed back on the ventilator to rest until all data regarding the weaning response can be assessed.

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10. Notify the team of the results of trials. If the last step of the weaning plan or protocol has been attained, consider extubation. If a protocol is used, this step may be automatic.
11. Discard supplies, remove PPE, and perform hand hygiene.
12. Document the procedure in the patient's record.

SIMV Weaning Method

1. Perform hand hygiene and don gloves. For patients with isolation precautions, also don a gown, mask, and eye protection.
2. Verify the correct patient using two identifiers.
3. Explain the procedure to the patient and ensure that he or she agrees to treatment.
4. Position the patient for optimum ventilation. Positions for optimum ventilation vary, but most patients should be positioned with the head of the bed elevated 30 degrees or higher.¹
5. Communicate with the patient and family throughout the weaning process.
6. Suction the artificial airway to ensure patency.
7. Gradually and progressively decrease SIMV breaths.

Rationale: This method of weaning provides a gradual reduction of ventilator support. The preset breaths are progressively decreased as the patient assumes a greater proportion of the minute volume with spontaneous breathing.²

Some IMV and SIMV demand valves offer high resistance to spontaneous breathing. Work of breathing may be greatly increased and cause fatigue, especially at low IMV rates. To avoid this, add PSV.

- a. PSV is commonly used between IMV breaths to offset the work associated with small tube sizes, circuit resistance, and high breathing rates.
 - b. The method has largely been replaced with SBTs, using a T-piece or CPAP, because they are easier to accomplish.
 - c. If SIMV is used, have a plan in place for progressive weaning and predetermine a clinical end point. A plan that clearly describes the end point of this method is essential.
8. Assess the patient for the signs and symptoms of fatigue, inadequate gas exchange, and impaired breathing pattern with decreases in the SIMV rate.

Lower levels of IMV, when not used with PSV, are similar to strength-conditioning trials. Ensure adequate rest times between trials and at night.

9. Notify the team of the results of trials. If the last step of the weaning plan or protocol has been attained, consider extubation. If a protocol is used, this step may be automatic.
10. Discard supplies, remove PPE, and perform hand hygiene.
11. Document the procedure in the patient's record.

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PSV Weaning Method

1. Perform hand hygiene and don gloves. For patients with isolation precautions, also don a gown, mask, and eye protection.
2. Verify the correct patient using two identifiers.
3. Explain the procedure to the patient and ensure that he or she agrees to treatment.
4. Position the patient for optimum ventilation. Positions for optimum ventilation vary, but most patients should be positioned with the head of the bed elevated 30 degrees or higher.¹
5. Communicate with the patient and family throughout the weaning process.
6. Suction the artificial airway to ensure patency.
7. Set the PSV level at maximum (PSV max) and decrease the level according to the organization's practice or as clinically indicated (e.g., no signs of intolerance).

Rationale: PSV max is the level that attains the absence of increased work of breathing and allows for suitable VT according to the patient's demand. Higher respiratory rates and smaller VT values are generally acceptable during trials. Full support should be ensured at night and for rest, especially early in the weaning process.

Be cautious when using high levels of PSV with patients who have obstructive lung conditions because the higher levels may promote overdistention and air trapping.

8. Monitor the patient's responses to weaning. Return the patient to full ventilatory support if signs of intolerance occur and when the intended duration of trial has been reached.

Rationale: PSV, despite requiring spontaneous effort, reduces the work of breathing associated with circuits, endotracheal tubes, and high breathing rates. However, fatigue is possible if the level is not appropriately set. Alternately, PSV can provide relief and rest to the respiratory muscles.

9. When the clinical goal for PSV weaning is accomplished, discuss extubation with the practitioner. If a protocol is used, the next step may be automatic.
10. Discard supplies, remove PPE, and perform hand hygiene.
11. Document the procedure in the patient's record.

MONITORING AND CARE

1. Evaluate the patient for signs and symptoms of intolerance and respiratory muscle fatigue. If signs of intolerance occur, promptly return the patient to supported ventilation.
 - a. Frequency of evaluation may vary depending on how long the patient has been on the ventilator and the patient's stability.
 - b. A multidisciplinary approach is encouraged.

Hemodynamic instability should result in a return to ventilatory support until the patient is stable.

- c. Continuous ETCO₂ monitoring should be done if available.

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2. Observe the patient for signs or symptoms of pain. If pain is suspected, report it to the authorized practitioner.

EXPECTED OUTCOMES

- Timely and successful discontinuance of mechanical ventilation
- Comfortable and adequate breathing pattern during the weaning process

UNEXPECTED OUTCOMES

- Tracheal injury
- Pulmonary barotrauma
- Cardiovascular depression
- Fatigue
- Hypoxemia
- Hypercapnia
- Dyspnea
- Unsuccessful weaning trials
- Inadvertent extubation

DOCUMENTATION

- Patient and family education
- Individualized goals for weaning
- Procedure used for weaning (e.g., T-piece, decreasing IMV or SIMV support, PSV, flow-by PEEP, or CPAP)
- Parameters used to assess patient readiness to wean and weaning trial tolerance, including clinical indicators
- Patient response to decrements in mechanical ventilation support
- Mode or method of weaning
- Duration of trial
- Level of support (if appropriate, as in PSV, flow-by PEEP, or CPAP)
- Unexpected outcomes and related interventions

REFERENCES

1. Altobelli, N. (2017). Chapter 36: Airway management. In R.M. Kacmarek, J.K. Stoller, A.J. Heuer (Eds.), *Egan's fundamentals of respiratory care* (11th ed., pp. 739-789). St. Louis: Elsevier.
2. Gupta, P. and others. (2014). The effect of a mechanical ventilation discontinuation protocol in patients with simple and difficult weaning: Impact on clinical outcomes. *Respiratory Care*, 59(2), 170-177. doi:10.4187/respcare.02558 ([Level IV](#))

ADDITIONAL READINGS

- Azeredo, L.M. and others. (2016). The integrative weaning index in elderly ICU subjects. *Respiratory Care*, respcare.04524. Epub ahead of print. doi:10.4187/respcare.04524
- Holets, S.R., Marini, J.J. (2016). Is automated weaning superior to manual spontaneous breathing trials? *Respiratory Care*, 61(6), 749-760. doi:10.4187/respcare.04329
- Kacmarek, R.M. (2017). Chapter 52: Discontinuing ventilatory support. In R.M. Kacmarek, J.K. Stoller, A.J. Heuer (Eds.), *Egan's fundamentals of respiratory care* (11th ed., pp. 1190-1215). St. Louis: Elsevier.

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Lu, Z. and others. (2016). Diaphragmatic dysfunction is characterized by increased duration of mechanical ventilation in subjects with prolonged weaning. *Respiratory Care*, 61(10), 1316-1322. doi:10.4187/respcare.04746

Piraino, T. (2017). Chapter 51: Monitoring the patient in the intensive care unit. In R.M. Kacmarek, J.K. Stoller, A.J. Heuer (Eds.), *Egan's fundamentals of respiratory care* (11th ed., 1154-1189). St. Louis: Elsevier.

Sklar, M.C. and others. (2016). Effort to breathe with various spontaneous breathing trial techniques. A physiological meta-analysis. *American Journal of Respiratory and Critical Care Medicine*, Oct 21. Epub ahead of print.

Elsevier Skills Levels of Evidence

- Level I - Systematic review of all relevant randomized controlled trials
- Level II - At least one well-designed randomized controlled trial
- Level III - Well-designed controlled trials without randomization
- Level IV - Well-designed case-controlled or cohort studies
- Level V - Descriptive or qualitative studies
- Level VI - Single descriptive or qualitative study
- Level VII - Authority opinion or expert committee reports

Supplies

- Digital readout of VT and respiratory rate
- Spirometer
- If T-piece or tracheostomy collar setup is required: flow meter with functional heated aerosol humidifier (with inline thermometer and water trap)
- Tracheostomy collar or T-piece adapters
- PPE (gloves, mask, eye protection, gown)
- Pressure manometers
- Weaning protocol or weaning plan
- Extubation equipment
- Suctioning equipment

Clinical Review: Christine J. Moore, DHSc, NPS-RRT, CPFT
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