Mechanical Ventilation Settings and Basic Modes

Mechanical ventilation is utilized in intensive care and long-term care settings to assist patients who require additional respiratory support. It is indicated for acute or chronic respiratory failure, which is defined as insufficient oxygenation, insufficient alveolar ventilation, or both. Benefits of mechanical ventilation are improved gas exchange and decreased work of breathing. Use this handy reference guide to help you safely manage oxygenation and ventilation goals for your patients on ventilator therapy.

DEFINITIONS	
Fraction of Inspired Oxygen (FiO_2)	Concentration of oxygen in the inspired air. Use the lowest FiO_2 that achieves the targeted oxygenation. Avoid prolonged $FiO_2 > 0.60$, as this may cause oxygen toxicity.
Frequency (f) or Respiratory Rate (RR) (10-20 breaths/min)	Set number of ventilator breaths per minute. Actual RR includes the spontaneous breaths taken by the patient. Hypoventilation may cause respiratory acidosis; hyperventilation may cause respiratory alkalosis.
Trigger	Breaths can be triggered by: • Timer (ventilator-initiated breaths) – occur at the set respiratory rate or frequency (f). • Patient effort (patient-initiated breaths) – occur when the patient causes sufficient change in either the pressure or flow in the circuit.
Target	Flow of air into the lung can target a predetermined flow rate (i.e. peak inspiratory flow rate) or pressure limit.
Termination	Signal for a ventilator to end inspiration may be related to volume (i.e. tidal volume), time (i.e. predetermined duration of

	inspiration), or flow (decrease in inspiratory flow to a percentage of peak value).
Tidal Volume (V_t) [6-8 mL/kg of ideal body weight (IBW) to prevent barotrauma]	Volume of gas exchanged with each breath. A lower V_t is indicated in patients with stiff, non-compliant lungs. Higher V_t may cause tachycardia, decreased blood pressure and lung injury.
Minute Ventilation (V_E) (5-10 L/minute)	Volume of gas exchanged per minute = (respiratory rate) x (tidal volume).
Inspiratory: Expiratory (I:E) Ratio	Normal: longer expiratory phase than inspiratory phase (1:2, 1:3). Inverse ratios provide a longer inspiratory phase (1:1, 2:1, 3:1, 4:1).
Positive End Expiratory Pressure (PEEP) (3-10 cm H_2O)	Pressure remaining in the lungs at end expiration. Used to keep alveoli open and "recruit" more alveoli to improve oxygenation for patients. High levels may cause barotrauma, increased intracranial pressure and decreased cardiac output.
Pressure Support (PS) (8-20 cm H_2O)	Provides additional pressure during inspiration to ensure a larger V_t with minimal patient effort. Used to help overcome the work of breathing through ventilator tubing.
Peak Inspiratory Pressure (PIP)	Highest proximal airway pressure reached during inspiration. Target PIP is < 35 cm H_2O. Low PIP may result in hypoventilation; high PIP may cause lung damage.
Peak Flow Rate	Maximum flow delivered by the ventilator during inspiration.

BASIC INVASIVE MODES OF MECHANICAL VENTILATION	
MODE	**DESCRIPTION**
Assist Control (AC) *[aka Continuous Mandatory Ventilation (CMV)]*	• Each breath is either an assist (patient-initiated) or control (ventilator-initiated) breath with guaranteed tidal volume. • Patient receives full ventilator support for all spontaneous breaths. • Prolonged use may weaken respiratory muscles. • May be pressure or volume cycled/controlled.
Assist Control Volume Ventilation	• Patient receives a set V_t and V_E with each assisted and controlled breath. • Does not limit peak inspiratory pressure.
Assist Control Pressure Ventilation	• Ventilator delivers breath until set pressure is reached. • Limits peak inspiratory pressure.
Synchronous Intermittent Mandatory Ventilation (SIMV)	• Provides full support to the preset V_t (volume-controlled) or pressure limit (pressure-controlled) for each ventilator-generated breath. • May be used to wean patient from ventilator.
Airway Pressure Release Ventilation (APRV)	• CPAP level support with the addition of short (1-1.5 second) pressure releases to improve oxygenation and eliminate CO_2. • Inverse I:E ratio improves alveolar recruitment. • High pressure and PEEP improve atelectasis, but may cause pneumothorax.
Pressure Support Ventilation (PSV)	• Set pressure during inspiration to augment spontaneous breathing. • Used to decrease the work of breathing. • Tidal volume depends on patient's effort and lung elasticity.
Continuous Positive Airway Pressure (CPAP)	• Spontaneous mode: no set V_t or f (RR). PEEP keeps alveoli open, and PS overcomes work of breathing through tubing. • Used to wean patient from ventilator and indicated in obstructive sleep apnea.

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