

Oxygenation and Ventilation of COVID-19 Patients

Module 3: Ventilation Equipment

In collaboration with



American Society of
Anesthesiologists



American Association
for Respiratory Care

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Products are shown for demonstration purposes only.
The American Heart Association does not endorse or recommend any specific manufacturer or product.

To show skills clearly, the healthcare providers shown do not always use recommended personal protective equipment (such as gloves, masks, face shields).

3 categories of ventilators



Pneumatic: Driven by a gas source to pressurize the circuit



Electrical: Uses electricity to drive a piston or turbine to ventilate



Electrical/pneumatic: Uses electrical valves or solenoids, but uses a pressurized gas source to ventilate

Examples only, may not be representative of all ventilators

Terms

- Tidal volume (VT): Volume per breath
 - Set tidal/measured = 5-8 mL/Kg predicted body weight (PBW)
 - Inspired exhaled = Usually within 50 mL
- Respiratory rate
 - Mandatory = Set
 - Spontaneous = Measured spontaneous rate with or without assistance
 - Total = Measured mandatory + spontaneous
- Minute ventilation: Amount of volume the patient received over a minute
 - Tidal volume \times respiratory rate = minute ventilation (L/min)
 - 70-120 mL/kg/min PBW

Terms (cont.)

- Inspiratory time
 - Adults: 0.7-1.2
 - Pediatrics: 0.5-0.8
 - Neonate: 0.3-0.5
- Airway pressure
 - Peak airway pressure (PIP or controlled mean airway pressure [Paw]): Highest pressure measured during inspiration; <30 cm H₂O
 - Plateau pressure (Pplt): Pressure measured a maximum inspiration and zero flow <25 cm H₂O
 - PEEP: Pressure measured at the end of the expiratory phase
 - CPAP: Positive airway pressure that is constant throughout inspiration and exhalation
- FIO₂
 - Fraction of inspired oxygen = $<40\%$

Modes of ventilation

- Primary ventilator modes
 - Assist/control (A/C) mode: The ventilator delivers a set minimum number of mandatory breaths each minute. A/C mode can be used with either pressure control or volume control.
 - Synchronous intermittent mandatory ventilation (SIMV) mode: The ventilator delivers a set minimum number of mandatory breaths each minute but also allows the patient to breathe spontaneously in between the mandatory breaths. SIMV can be used with either pressure control or volume control.

Modes of ventilation (cont.)

- Secondary ventilator modes
 - Airway pressure release ventilation (APRV): APRV is an applied continuous positive airway pressure that at a set timed interval releases the applied pressure. Occasionally used in those with severe acute respiratory distress syndrome (ARDS).
 - Pressure regulated volume control (PRVC): This is a pressure-controlled mode but adds a targeted tidal volume, so the inspiratory pressure changes breath-to-breath to achieve the targeted tidal volume.

Federal stockpile ventilator resources



Uni-vent 754



LP-10



LTV 1200

Examples only, may not be representative of all stockpile resources

Basic functions: Setup

- Plug the ventilator into electricity using a red (generator backup) outlet and gas outlets/tank as appropriate
- Attach ventilator circuit
- Perform the pre-use check by following the directions on the screen
- Set initial ventilator setting

Basic functions: Adjustment

- For adjustments on most ventilators
 - Select and press the parameter you want to adjust
 - Adjust by turning to new setting
 - Confirm/accept the change
 - If you do not confirm, the ventilator will revert to previous setting

Basic function: Safety

- Alarms are important and must be set
- Typical settings are
 - Low pressure: Often a manufacture preset (not a user setting)
 - Low PEEP 2-4 cm H₂O below set PEEP
 - Minute ventilation
 - High alarm: 2 times current minute ventilation
 - Low alarm: Half the current minute ventilation
 - High respiratory rate: 30-40
 - Peak airway pressure alarm: 5-10 above current peak airway pressure
 - Tidal volume: Rarely set

These are guidelines; please follow your institutional protocol

Filtering of exhaled gases

- Setup video
- Demo HEPA type of filtering
- Discuss risks