

# Ventilator Management

## Indications for mechanical ventilation

<i>Hypoxemia</i>	<i>Hypercapnia</i>	<i>Clinical</i>
pO <sub>2</sub> < 55 torr or SO <sub>2</sub> < 92% despite supplemental inspired oxygen	pCO <sub>2</sub> > 44 torr acutely; or pCO <sub>2</sub> elevated chronically with pH < 7.25 despite non-invasive ventilation assist devices.	Respiratory distress accompanied by shock or somnolence.

### Physician Orders:

Intubate patient: Oral ET tube size  $\geq 7.0$  (in adults) to avoid high airway resistance, suctioning difficulty, and possible occlusion from mucus and blood.

### Initial Ventilator Settings:

Mode	Assist/Control (A/C*) or Intermittent Mandatory Ventilation (IMV*):
Inspired Oxygen (FIO <sub>2</sub> )	Select FIO <sub>2</sub> based on PaO <sub>2</sub> from previous ABG, or empirically start at FIO <sub>2</sub> = 1.0 and decrease until SO <sub>2</sub> = 94% (paO <sub>2</sub> approximately 75 torr).
PEEP (cmH <sub>2</sub> O)	Begin at 5 to provide physiologic backpressure lost by the ET tube bypassing glottal muscles. Increase PEEP in increments of 2.5 to PEEP maximum* if the FIO <sub>2</sub> $\geq 0.6$ .
Respiratory Rate (RR)	Begin at 8 – 12/min. Increase the RR if the patient's spontaneous RR > 6 above the set RR.
Tidal Volume (VT)	Patients without ARDS: Begin at 8 or 10 mL/KG and round off to the nearest 50 mL. Patients with ARDS: Use 6 ml/kg of ideal body weight
Nebulizer treatments	Albuterol, ipratropium bromide when indicated, frequency: at least q4h. See <u>CPD acute respiratory failure</u> and <u>Acute exacerbation of asthma</u> . Consider 2% bicarbonate solutions as mucolytic based on sputum viscosity.

### Physician orders to adjust ventilator after initial settings and ABG:

<u>Oxygenation (PO<sub>2</sub>)</u>	<u>Ventilation (PCO<sub>2</sub>)</u>
Adjust FIO <sub>2</sub> and PEEP to alter SaO <sub>2</sub> .	Adjust RR and VT to alter pCO <sub>2</sub> and pH.
↓	↓
The SaO <sub>2</sub> varies directly with the FIO <sub>2</sub> and PEEP.	The pCO <sub>2</sub> varies inversely with the VE* (RR x VT)
↓	↓
For hypoxemia (SaO <sub>2</sub> < 94%) requiring FIO <sub>2</sub> > 0.6, first increase PEEP from 5 cm H <sub>2</sub> O in steps of 2.5 to a PEEP maximum*	If pH < 7.35, increase VE (to lower pCO <sub>2</sub> ) by increasing RR by 2/min to a maximum of 30; if acidemia persists, consider increasing VT in steps of 50 mL to maximum of 15mL/kg with the following caveats:
↓	↓
If hypoxemia persists, then increase the FIO <sub>2</sub> in steps of 0.10 until 1.0 is reached or SO <sub>2</sub> >93%.	<ul style="list-style-type: none"> <li>• In ARDS, high VT causes alveolar damage; Limit VT (~6 ml/kg ideal body weight) to keep plateau pressure <math>\leq 30</math>. May allow permissive CO<sub>2</sub> retention and lower pH.</li> <li>• In COPD or asthma, high VE may cause autopeep. Autopeep should be measured before increasing VE. Aim for pH ~7.35, not for normal PCO<sub>2</sub>; minimize autopeep; keep plateau pressure &lt; 30 and allow permissive CO<sub>2</sub> retention.</li> </ul>
↓	↓
For SO <sub>2</sub> > 95% at PEEP maximum*, FIO <sub>2</sub> is first reduced in steps of 0.10 until $\leq 0.6$ , then PEEP is reduced in steps of 2.5 to a minimum of 5 before further reductions of FIO <sub>2</sub> .	If pH > 7.45, decrease VE (to raise pCO <sub>2</sub> ) by decreasing RR by 2 until $\leq 8$ , then decrease VT in steps of 50 mL. If patient's RR remains elevated despite the ventilator RR reduction, consider sedation.

Pulmonary consultation should be considered for any patient on a ventilator and should be obtained for patients with ARDS or ventilator failure due to any primary pulmonary disease state.

### \*Definitions:

A/C: Patient receives a set volume for every breath triggered by either patient effort (assist), or by time (control, based on the set Respiratory Rate).

IMV: Patient receives a set volume for the set Respiratory Rate, additional spontaneous breaths (non-set volume) can be taken at any time.

PEEP maximum: Positive End Expiratory Pressure (PEEP) producing improved oxygenation without significant compromise in hemodynamics, such as cardiac output, mixed venous saturation, and BP.

VE: Minute ventilation = Respiratory Rate x Tidal Volume

SaO<sub>2</sub>: Arterial oxygen saturation

ARDS Network. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. N Engl J Med 342: 1301-1308, 2000

Branson RD. Monitoring ventilator function. Crit Care Clin 11:127-143, 1995.

Tobin MJ. Mechanical ventilation. N Engl J Med 330:1056-1061, 1994.

Hinson JR, Marinii JJ. Principles of mechanical ventilator use in respiratory failure. Ann Rev Med 43:341-361, 1992.