

MIT E-Vent | MIT Emergency Ventilator

Emergency ventilator design toolbox

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Key Ventilation Specifications

From the Clinical Guidance this document summarizes the minimum set of requirements for ventilation:

1. Patients must be under the management of a trained clinician.
2. The minimum controllable parameters in order to ventilate a patient include:
 1. **BPM** (breaths per minute): between **8 – 30 BPM**
 2. **Tidal Volume** (air volume pushed into lung): between **200 – 800 mL** based on patient weight
 3. **I/E Ratio** (inspiratory/expiration time ratio): recommended to start around **1:2; best if adjustable between range of 1:1 – 1:4***
3. Airway pressure must be monitored
 1. Maximum pressure **should be limited to 40 cm H₂O** at any time; Plateau pressure **should be limited to max 30 cm H₂O**
 2. The use of a **passive mechanical blow-off valve** fixed at 40 cm H₂O is strongly recommended
 3. Clinician require readings of plateau pressure and PEEP (refer to clinical documentation tab)
 4. PEEP of **5-15 cm H₂O** required; many patients need 10-15 cmH₂O
4. Failure conditions must permit conversion to **manual clinician override**, i.e. if automatic ventilation fails, the conversion to immediate ventilation must be immediate.
5. **Ventilation on room air is better than no ventilation at all.** Blending of oxygen and air gas mixture to adjust FiO₂ is not important in an emergency scenario. It is certainly nice to have that ability and can easily be implemented with an oxygen / air gas blender that some hospitals already have.
6. Covid-19 can get aerosolized (airborne), so **HEPA filtration on the patient's exhalation is required or between the ventilator unit and the patient (at the end of the endotracheal tube)** to protect clinical staff from certain infection. In-line HEPA filters can usually be purchased alongside manual resuscitator bags.
7. Heat and moisture exchanger should be used in line with the breathing circuit.
8. Failure conditions must result in an alarm.

This is a minimal requirement set for emergency use. Equipment designed for more regular use, even if for emerging markets, will require additional features to be used on a regular basis.

*Range determined based on several COVID-19 patients' ventilator settings reported from Boston area ICUs

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