

PARKLAND HEALTH & HOSPITAL SYSTEM
Nursing Services

Section: Respiratory
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Distribution: Nursing Procedure Manual

**CARE OF THE NON-NEONATAL PATIENT REQUIRING CONTINUOUS
MECHANICAL VENTILATION**

PRACTICE

STATEMENT: The credentialed Registered Nurse is assigned to the patient requiring mechanical ventilation.

Any patient requiring a ventilator will be frequently monitored.

All ventilator alarms will be on at all times.

Neonatal care, refer to Nursery Services Procedure Manual # 2600.08
Care of Patient Requiring Continuous Conventional Mechanical
Ventilation [http://intranet.pmh.org/home/PP-
Index/NICU/2600/2600.08.doc](http://intranet.pmh.org/home/PP-Index/NICU/2600/2600.08.doc)

PURPOSE: To provide adequate alveolar ventilation and adequate tissue oxygenation.

To provide constant supervision of the patient on a ventilator.

EQUIPMENT: Ventilator as ordered by the Provider
Compressed air and oxygen outlets
Extra endotracheal and/or tracheotomy tubes, same size
Suction equipment
Manual self-inflating resuscitation bag (with PEEP valve if PEEP level is greater than 5cm H₂O)
Appropriately sized resuscitation facemask
Electrocardiogram and pulse oximetry

PROCEDURE:

1. Refer to procedure "Assisting with Endotracheal Intubation," NSG 34-04 <http://intranet.pmh.org/home/PP-Index/Nursing/34-04.pdf> Nursing Manual, if applicable.
2. Notify the respiratory therapist who will obtain a ventilator and establish ventilatory settings according to provider's orders.
3. Ventilator settings will be documented on the ICU Flow Sheet upon initiation, with each assessment (every four hours) and upon any changes. The assigned nurse shall at all times be aware of the following ventilator parameters:

- a. Mode of ventilation
 - b. FiO₂
 - c. Tidal Volume/Exhaled tidal volume
 - d. Frequency (total and mandatory)
 - e. PEEP level
 - f. I:E ratio/Inspiratory time
 - g. Peak inspiratory pressure
 - h. Minute Ventilation
4. Arterial blood gases should be drawn 30-60 minutes after initiation of mechanical ventilation, or ventilator changes unless specifically ordered otherwise. Report abnormal results to the provider and treat as ordered.
 5. Ventilator checks will be done and documented by the assigned nurse every four hours.
 6. Ventilator alarms will be on at all times. The nurse will verify activation of all alarms each shift and document on the appropriate flowsheet. If a ventilator alarm setting is not set appropriately, the nurse will notify the Respiratory Therapist.
 7. The endotracheal tube will be secured with adhesive and/or trach tape and it will be changed and adjusted to prevent pressure areas. Tape will be kept clean and dry and will be changed every 24 hours and as needed. Circumferential tape should be avoided with head injury patients. A safety pin may be used to secure ET tubes in the BICU.
 8. Bite blocks may be utilized when patients with endotracheal tubes are agitated and/or biting the tube.
 9. The nurse will assess for patient-ventilator dyssynchrony and evaluate possible causes:
 - a. Improper placement of tube
 - b. Kinking of tube
 - c. Improper ventilator settings
 - d. Pneumothorax
 - e. Anxiety
 - f. Need for suctioning
 10. If no mechanical reason is found notify the respiratory therapist and consult the provider for possibility of giving sedative, analgesic and/ or chemical paralytic agent(s). An analgesic and/or sedative agent must be administered when administering a chemical paralytic agent.

11. A manual self-inflating resuscitation bag and facemask shall be kept at the bedside connected to oxygen source. Patient on PEEP >5 cm H₂O should have a PEEP valve attached to resuscitation bag.
12. Suction the patient as necessary utilizing sterile technique. Refer to procedure NSG 34-06 <http://intranet.pmh.org/home/PP-Index/Nursing/34-06.pdf> Suctioning of Adult Patient: Blind Endotracheal. Tracheostomy, Endotracheal Tube, Oral, and Nasopharyngeal.
13. Prior to suctioning, hyperoxygenate with 100% O₂. While suctioning, closely observe patient's color, and ECG rhythm for bradycardia/tachycardia greater than 10%, PVC's or decreased oxygen saturation by $\geq 10\%$.
14. Breath sounds will be auscultated at least every 4 hours and before and after suctioning, tube care and retaping.
15. Keep ventilator tubing clear of condensation (drain tubing from proximal to distal into a separate receptacle.).
16. Provide oral care every 4 hours and prn. Refer to procedure NSG 34-06 <http://intranet.pmh.org/home/PP-Index/Nursing/34-06.pdf> Suctioning of Adult Patient: Blind Endotracheal. Tracheostomy, Endotracheal Tube, Oral, and Nasopharyngeal.
17. Provide reality orientation by advising patient of day, date, place and other sensory input as tolerated.
18. Assess for G.I. distention, utilize nasogastric tube as ordered to prevent aspiration. Administer stress ulcer prophylaxis as ordered.
19. Provide DVT prophylaxis as ordered.
20. Explain all care to patient. Provide a means of communication such as writing paper or magic slate.
21. Provide patient and family education; document on appropriate form.
22. Document pertinent assessments and observations, and a review of systems every 4 hours on the Flow Sheet.

COMPLICATIONS AND/OR PROBLEMS:

1. The ventilator should be plugged into emergency power outlet. Should a power failure occur, the **FIRST** step is to obtain a manually inflating resuscitation bag and manually ventilate the patient. Continue to ventilate the patient manually until power is restored. Page Respiratory Therapy/Engineering for assistance if emergency power is not restored immediately.

2. Pneumothorax is a major complication of mechanical ventilation, other potential complications include, but are not limited to: Nosocomial pneumonia, stress ulcers, hemodynamic compromise, increased ICP and disorientation.
3. **POTENTIAL OF ENDOTRACHEAL TUBE PROBLEMS:**
Kinking, displacement, over-inflation or rupture of cuff, mucus plug, extubation and obstructing airway can occur at any time during: an arrest, while manually ventilating the patient, turning the patient, repositioning the patient's head faulty or leaking pilot balloon, etc.
4. Over-inflation may cause the cuff to herniate over end of the tube causing airway obstruction. High-pressure alarm will sound as one possible indication. Immediately deflate cuff and reinflate to minimal occlusive volume. Also all endotracheal tubes, even "low-pressure cuffs," can inflict severe, sometimes fatal, tracheal damage. A clinical rule is only instill the volume of air necessary to JUST prevent leakage.
5. Equipment must be readily available to reintubate in situations where the patient is inadvertently extubated, and/or if the cuff ruptures or develops a leak.
6. Appropriate size tubes need to be used to prevent secondary complications. In pediatric patients, ET tube sizes are calculated by:
$$\frac{\text{Age in years} + 16}{4}$$
7. Ventilator changes are routinely made by the Respiratory Care personnel. However, the provider may change the settings, but they must inform the Respiratory Therapist so the settings can be checked and documented by them. An order must be written in the medical records. In an emergency situation, the Respiratory Therapist is paged for assistance. (When the provider changes ventilator settings they must also set alarms for the new parameters as established by guidelines.)

SPECIAL TECHNIQUES IN MECHANICAL VENTILATION

Consult provider and respiratory care practitioner for specific recommendations regarding the care of the patient receiving the following modes of mechanical ventilation.

AIRWAY PRESSURE RELEASE VENTILATION (APRV)

Definition: mode of ventilation designed to provide two levels of continuous positive airway pressure (CPAP) and allow spontaneous ventilation on both levels when spontaneous effort is present.

Indications: Acute lung injury (ALI), Acute Respiratory Distress Syndrome (ARDS), refractory hypoxemia.

Contraindications: Obstructive lung disease (COPD, asthma).

Documentation of settings includes:

- a. Mode
- b. FiO₂
- c. Pressure high (P_{high})
- d. Pressure low (P_{low})
- e. Time high (T_{high})
- f. Time low (T_{low})
- g. Exhaled Tidal Volume (release volumes only)
- h. Minute Volume

HIGH FREQUENCY OSCILLATORY VENTILATION (HFOV)

Indications: ALI, ARDS, refractory hypoxemia

Documentation of settings includes:

- a. Mode
- b. FiO₂
- c. Power
- d. Amplitude
- e. Frequency (Hz)
- f. Inspiratory time (%)

VOLUMETRIC DIFFUSIVE RESPIRATOR (VDR)

Indications: Inhalation injury, aspiration, ALI/ARDS, refractory hypoxemia, mucous plugging, unilateral lung disease.

Documentation of settings include:

- a. Mode
- b. FiO₂
- c. Frequency
- d. Peak Inspiratory Pressure
- e. Oscillatory PEEP
- f. Demand PEEP
- g. Oscillations/min (set by RT)

GUIDELINES FOR ADULT VENTILATOR ALARMS

The following alarms must be set and documented on all adult ventilated patients.

Peak Inspiratory Pressure

Peak inspiratory pressure alarms will be set at ≤ 20 cmH₂O above the patient's peak inspiratory pressure.

Low Inspiratory Pressure

Low inspiratory pressure alarms will be set at ≥ 15 cmH₂O below the patient's peak inspiratory pressure.

High Tidal Volume

High-inspired tidal volume alarms will be set at $\leq 50\%$ above the set or average tidal volume. Patients on sigh breaths or recruitment maneuvers may have the alarm set $\leq 25\%$ above the average sigh tidal volume.

High Minute Ventilation

High minute ventilation alarms will be set at ≤ 5 liters above the set or average total minute ventilation.

Low Minute Ventilation Alarm

Low minute ventilation alarms must be set at $\geq 80\%$ of the prescribed minute ventilation. The low minute ventilation alarm will not be set < 3 liters. For patients on a spontaneous breathing mode, the low minute volume alarm must be set at $\geq 75\%$ of the average minute ventilation.

High Respiratory Rate

The high respiratory rate alarm will be set at ≤ 15 above the average spontaneous respiratory rate.

Apnea Interval

The apnea interval will be set at ≤ 20 seconds.

PRESET VENTILATOR ALARMS

Evita 4: Low Pressure Alarm

The low pressure alarm on the Evita 4 is preset at 5 cmH₂O above the set PEEP level.

SPECIALTY VENTILATOR ALARMS

Sensormedics 3100B (Adult)

High MAP alarm: Must be set ≤ 5 cmH₂O above set MAP.
Low MAP alarm: Must be set ≥ 5 cmH₂O below set MAP.

The high MAP limit on the 3100B is set by the high MAP alarm setting. If the high MAP alarm setting is reached, the pressure in the system will drop and attempt to ramp back up to the set MAP. This will present as a rapid rise and fall of the MAP on the machine.

VDR

High and low peak pressure alarms on the Monitron must be set at 5 – 10 cmH₂O above and below the PIP read on the monitron. The low PIP alarm should be set at least 5 cmH₂O above the total PEEP.

Important: Alarm ranges pertain to user set alarms and not alarms automatically set by the microprocessor of the ventilator. Frequent alarms are dealt with on a patient-by-patient basis with interaction of the respiratory therapist and nursing. ALARMS SET OUTSIDE OF THESE GUIDELINES SHOULD BE DOCUMENTED IN THE MEDICAL RECORD.

GUIDELINES FOR PEDIATRIC VENTILATOR ALARMS

The following alarms must be set and documented on all pediatric ventilated patients.

Peak Inspiratory Pressure

Peak inspiratory pressure alarms will be set at ≤ 15 cmH₂O above the patient's peak inspiratory pressure.

Low Inspiratory Pressure

Low inspiratory pressure alarms will be set at ≥ 10 cmH₂O below the patient's peak inspiratory pressure.

High Tidal Volume

High inspired tidal volume alarms will be set at $\leq 25\%$ above the set or average tidal volume.

High Minute Ventilation

High minute ventilation alarms will be set at $\leq 25\%$ above the set or average minute ventilation.

Low Minute Ventilation Alarm

Low minute ventilation alarms must be set at $\geq 80\%$ of the prescribed minute ventilation. For patients on a spontaneous breathing mode, the low minute volume alarm must be set at $\geq 75\%$ of the average minute ventilation.

High Respiratory Rate

The high respiratory rate alarm will be set at ≤ 15 above the average spontaneous respiratory rate.

Apnea Interval

The apnea interval will be set at ≤ 20 seconds.

SPECIALTY VENTILATOR ALARMS

Sensormedics 3100A (Infant/Pediatric)

High MAP alarm:	Must be set at ≤ 3 cmH ₂ O above set MAP
Low MAP alarm:	Must be set at ≥ 3 cmH ₂ O below set MAP
MAP limit: MAP	Set off the patient at 10 cmH ₂ O above desired MAP

Important: Alarm ranges pertain to user set alarms and not alarms automatically set by the microprocessor of the ventilator. Frequent alarms are dealt with on a patient-by-patient basis with interaction of the respiratory therapist, and nursing. ALARMS SET OUTSIDE OF THESE GUIDELINES SHOULD BE DOCUMENTED IN THE MEDICAL RECORD.

Bear Cub 750: Low Pressure Alarm

Low pressure (disconnect) alarm:	$[(PIP - PEEP)/4] + PEEP$
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VIP Bird: High Pressure Alarm

In Time Cycled Modes the high pressure limit sets the PIP, the high pressure limit is 10 cmH₂O above the PIP.

SPECIALTY VENTILATOR ALARMS

Sensormedics 3100A (Neonatal)

High MAP alarm: MAP	Must be set at ≤ 3 cmH ₂ O above set MAP
Low MAP alarm:	Must be set at ≥ 3 cmH ₂ O below set MAP
MAP limit: desired MAP	Set off the patient at 10 cmH ₂ O above desired MAP

INO Vent

NO alarm:	Must be set at ± 5 ppm of ordered NO level
NO ₂ alarm:	Must be set at 3 ppm
F ₁ O ₂ alarm:	Must be set at + 10% of downstream F ₁ O ₂

Important: Alarm ranges pertain to user set alarms and not alarms automatically set by the microprocessor of the ventilator. Frequent alarms are dealt with on a patient-by-patient basis with interaction of the respiratory therapist and nursing. ALARMS SET OUTSIDE OF THESE GUIDELINES SHOULD BE DOCUMENTED IN THE MEDICAL RECORD.