



<b>Department:</b>	Respiratory Care Services		
<b>Document:</b>	Multidisciplinary Policy and Procedure		
<b>Title:</b>	Mechanical Ventilation - Infants		
<b>Applies To:</b>	Respiratory Therapy Staff, Physicians, Nurses in PICU and NICU		
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## 1. PURPOSE:

- 1.1 To describe the management and procedures in providing mechanical ventilation support in infants..

## 2. DEFINITONS:

- 2.1 **Mechanical Ventilation** — an artificial device to assist a patient to breathe.

## 3. POLICY:

- 3.1 Mechanical ventilation is indicated for infants having:
  - 3.1.1 Apnea (prolonged or repetitive unresponsive apnea associated with bradycardia or cyanosis).
  - 3.1.2 Respiratory failure in newborns:
    - 3.1.2.1  $\text{PaO}_2 < 50 \text{ mm Hg}$  on  $\text{FiO}_2 \geq 0.6$
    - 3.1.2.2  $\text{PaCO}_2 > 70 \text{ mm Hg}$
    - 3.1.2.3  $\text{pH} < 7.20$
  - 3.1.3 Impending ventilatory failure (worsening oxygenation and/ or severe respiratory distress).
  - 3.1.4 Congenital anomalies affecting ventilatory function (diaphragmatic hernia).
  - 3.1.5 Infants with low Apgar Scores and responding poorly to resuscitation efforts.
  - 3.1.6 Infants with severe sepsis and unstable vitally or with compromised pulmonary blood flow (e.g., Persistent Pulmonary Hypertension of the Newborn (PPHN)).
- 3.2 Mechanical ventilation Hazards/Precautions in infants include:
  - 3.2.1 Air leak syndromes (barotrauma or over-inflation):
    - 3.2.1.1 Pulmonary Interstitial Emphysema (PIE), pneumo-mediastinum/ pericardium/ peritoneum, pneumothorax, subcutaneous emphysema.
  - 3.2.2 Airway complication (intubation)
    - 3.2.2.1 Airway damage or necrosis, endotracheal (ET) tube air leak, kicking/ malposition/ obstruction, extubation (unplanned), laryngo/tracheo/ broncho/ (LTB) malacia, subglottic stenosis, increased work of breathing (WOB).
  - 3.2.3 Cardio or cerebrovascular complications.
    - 3.2.3.1 Decreased cardiac output (CO), increased intracranial pressure (ICP) and decreased venous return.
  - 3.2.4 Chronic lung disease (mechanical ventilation and Oxygen toxicity) (e.g., Broncho pulmonary dysplasia (BPD)).
  - 3.2.5 Endotracheal Tube (ETT) suctioning complications (e.g. hypoxia, bradycardia, air leaks).
  - 3.2.6 Infection (nosocomial) (e.g., pneumonia, tracheitis).
  - 3.2.7 Oxygen (increased risk of retinopathy of prematurity [ROP], oxygen radical disease)
  - 3.2.8 Patient-ventilator asynchrony.
  - 3.2.9 Technical complications.
    - 3.2.9.1 Failure of alarms, gas supply, circuit, humidifier, heater or ventilator.

- 3.2.10 Ventilator settings are inappropriate leading to:
  - 3.2.10.1 Auto-PEEP, hyper/hypoventilation, hyper/hypoxemia, increased WOB.
- 3.3 A blood gas, arterial or capillary, will be drawn within one (1) hour of initiation of ventilation, will constitute a standing order for all ventilated infants, and cannot be waived without a written order by the attending physician.
- 3.4 Only RCPs can set and adjust all ventilator settings.
  - 3.4.1 Nurses may adjust only FiO<sub>2</sub> when patients experience decreased levels of oxygen saturation (SpO<sub>2</sub>).
  - 3.4.2 RCP suggestions, modifications, or inputs on ventilator settings are allowed, only after discussion with a consultant or subordinates (assistant associate).

#### **4. PROCEDURE:**

- 4.1 Verify physician's order/request for correctness and completeness. The order should include:
  - 4.1.1 The ventilation mode i.e. volume or pressure ventilation
  - 4.1.2 Tidal volume (VT) or peak inspiratory pressure (PIP).
  - 4.1.3 Fractional inspired oxygen concentration (FiO<sub>2</sub>).
  - 4.1.4 Respiratory Rate (RR)
  - 4.1.5 Positive end-expiratory pressure (PEEP).
  - 4.1.6 Volume support guarantee, if applicable / if desired
  - 4.1.7 Pressure support (PS), if applicable
  - 4.1.8 Inspiratory time
- 4.2 Gather necessary equipment and supplies ensuring calibration if applicable.
  - 4.2.1 Infant ventilator
  - 4.2.2 Heated humidifier
  - 4.2.3 Humidifier chamber
  - 4.2.4 Sterile water
  - 4.2.5 Infusion tubing for the sterile water
  - 4.2.6 Ventilator circuit
  - 4.2.7 Temperature probe
  - 4.2.8 Flow sensor
  - 4.2.9 Heat and Moisture Exchange (HME)
  - 4.2.10 Bacterial filter
- 4.3 Ensure the presence and continued relevance of the current care plan.
- 4.4 Follow relevant infection control activities/guidelines (e.g. hand washing, glove, gown, mask, etc.).
- 4.5 Check patient identification (four names for Saudi/ complete name for the Non — Saudi and medical record number).
- 4.6 Explain the purpose and goals of intended activities to the parent(s); provide patient-family education as required
- 4.7 Assemble necessary equipment and supplies, ensuring proper operation.
  - 4.7.1 Connect the high-pressure hoses to the O<sub>2</sub> and air outlets.
  - 4.7.2 Connect the electric plug of the ventilator to the emergency outlet.
  - 4.7.3 Connect the humidifier chamber to the heated humidifier.
  - 4.7.4 Connect the auto-fill tubing from the humidifier to the bottle of sterile water.
  - 4.7.5 Turn on the heated humidifier.
  - 4.7.6 Connect the ventilator circuit
  - 4.7.7 Connect the temperature probe to the proximal port (near the humidifier) and the distal port (near the patient).
  - 4.7.8 Connect and calibrate the flow sensor to the ventilator circuit.
    - 4.7.8.1 VT may not be delivered if the preset TI limit is exceeded.
    - 4.7.8.2 The VT, PIP and TI may vary from breath-to-breath.
  - 4.7.9 VT: 4-6 ml/kg.
  - 4.7.10 PIP should remain < 30 cmH<sub>2</sub>O. Higher PIP's should be avoided Mean Airway Pressure (MAP) often the most critical factor in determining optimal gas exchange (oxygenation) as

it correlates with lung volumes and may be affected by factors including PEEP, TI, PIP, rate, and pressure waveform. Try not exceeding 13 cmH<sub>2</sub>O.

4.7.11 PEEP: infants with surfactant deficiency require low to moderate PEEP. Infants with abdominal distention may require high PEEP. PEEP > 5-6 cmH<sub>2</sub>O may begin to worsen compliance and > 10 cmH<sub>2</sub>O is rarely used in newborns. PEEP > 7 cmH<sub>2</sub>O should be used with caution in infants with airway obstruction, such as meconium aspiration or bronchiolitis.

4.7.12 Rate: High rates are commonly used in PPHN to induce mild respiratory alkalosis and decreased pulmonary vascular resistance (PVR), and in PIE and barotrauma - to reduce PIP and VT

4.7.13 TI: 0.25-0.4 sec (very low birth weight infants); 0.3-0.5 seconds (term infants).

4.7.14 Flow: 5-8 l/min (low birth weight infants); 6-10 l/min (term infants). In volume ventilation, set to lowest the value that will generate the desired PIP and pressure waveform. High flows may be needed to maintain VT when TI is shortened. However, flows > 10 l/m may result in increased VT due to increased turbulence in small endotracheal tubes and are associated with an increased risk of air-leaks.

4.7.15 Shorter TEs may result in auto-PEEP, decreased VT, and worsening oxygenation

4.7.16 I:E: Inverse ratios carry a high risk of auto-PEEP and the potential of hyperinflation, barotrauma, decreased cardiac output (CO), and cerebral injury.

4.7.17 FiO<sub>2</sub>: If the PaO<sub>2</sub> is known - use the same FiO<sub>2</sub> as adequate for spontaneous ventilation or bagging. If PaO<sub>2</sub> is unknown - use the minimum dosage necessary to keep neonate or infant pink until ABG can be obtained.

4.7.17.1 Inadequate FiO<sub>2</sub> may lead to hypoxemia and severe neurologic injury.

4.7.17.2 Excessive FiO<sub>2</sub> may lead to ROP in infants < 1500 grams (- PaO<sub>2</sub> > 100 mm Hg) or BPD in infants (- FiO<sub>2</sub> > 0.4 for prolonged periods).

4.8 Connect the patient to the ventilator and observe for adequate ventilation and oxygenation.

4.9 Set the ventilator alarms appropriately

4.10 Perform patient/ system check and document in the medical record.

4.11 Ensure appropriate communication with other health care workers, if indicated.

4.12 Clean, store, and discard any consumables and/ or equipment as appropriate

## 5. MATERIALS AND EQUIPMENT:

5.1 N/A

## 6. RESPONSIBILITIES:

6.1 Pediatric Intensive Care Unit Nurse

6.2 Neonatal Intensive Care Unit Nurse

6.3 Physicians

6.4 Respiratory Therapist

## 7. APPENDICES:

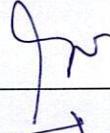
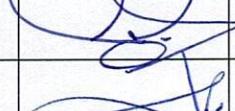
7.1 N/A

## 8. REFERENCES:

8.1 Oakes, D. (7 June 2015).Neonatal/ Pediatric Ventilation. Retrieved from <http://www.respiratoryupdate.com/members/department77.cfm>

8.2 King Abdullah bin Abdulaziz University Hospital, 2018.

**9. APPROVALS:**

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