

# Mechanical Ventilation Invasive

Setting: **Inpatient**    Population: **Pediatric**    Keywords: **device, VAP, ventilator, lung injury, ventilator-associated pneumonia, vent, breathing**

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## Clinical Description

Care of the hospitalized child experiencing the need for controlled or assisted breathing through an artificial airway.

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## Key Information

- Cuff must be deflated (if present) prior to using a speaking valve or capping a tracheostomy tube. Tubes used in children younger than 8 years of age may not have a cuff, as the tube is positioned in the narrowest portion of the cricoid cartilage and acts as the cuff.
  - Laryngeal mask airways may be used for short-term use to facilitate breathing; however, they do not offer aspiration protection and should be changed to an endotracheal tube if there is a need for a prolonged artificial airway.
  - To reduce the risk of pulmonary aspiration, a swallow evaluation should be performed prior to oral intake or feeding.
  - Pediatric-sized and smaller tracheostomies may not have an inner cannula. If an inner cannula is not present, the tracheostomy tube should be changed on a regular schedule to prevent obstruction of the single lumen.
  - Enteral feeding is preferred over parenteral due to physiologic benefits, such as gut integrity and function, stress ulcer prophylaxis and reduction of infection risk.
  - In patients younger than 8 years of age, there is no evidence to support the use of cuffed or uncuffed tubes. Clinician discretion should be used.
  - Evidence regarding pediatric ventilator-induced lung injury, lung protective measures and ventilator-associated pneumonia prevention originates from adult research.
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## Clinical Goals

By transition of care

A. The patient will demonstrate achievement of the following goals:

B. Patient, family or significant other will teach back or demonstrate education topics and points:

- Effective Communication
- Optimal Device Function
- Mechanical Ventilation Liberation
- Optimal Nutrition Delivery
- Absence of Device-Related Skin and Tissue Injury
- Absence of Ventilator-Induced Lung Injury
- Education: Overview
- Education: Self Management
- Education: When to Seek Medical Attention

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## Correlate Health Status

Correlate health status to:

- history, comorbidity, congenital anomaly
- age, developmental level
- sex, gender identity
- baseline assessment data
- physiologic status
- response to medication and interventions
- psychosocial status, social determinants of health
- barriers to accessing care and services
- child and family/caregiver:
  - health literacy
  - cultural and spiritual preferences
- safety risks
- family interaction
- plan for transition of care

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## Communication Impairment (Mechanical Ventilation, Invasive)

### Signs/Symptoms/Presentation

- agitation

- anxiety
- artificial airway present inhibiting vocalization
- fear
- frustration expressed
- irritability
- maladaptive communication behavior (e.g., facial expressions, hand/head movements)
- powerlessness
- social withdrawal
- soundless crying

## Problem Intervention(s)

### **Ensure Effective Communication**

- Acknowledge and validate intensity and complexity of voicelessness. Maintain eye contact when speaking and awaiting response.
- Promote calming presence. Involve patient in decision-making and care to promote inclusion, self-efficacy, confidence and sense of control.
- Establish a nonverbal communication method. Use augmentative techniques to preserve self-identity and self-esteem, such as writing tools, letter board, computer, flash cards or picture boards.
- If longer-term airway, consider alternative communication methods that facilitate speech, such as speaking valve, tracheostomy or capping. Evaluate need to deflate cuff when using these devices to allow exhalation.
- Keep call system within reach; adapt to meet needs.
- Assess and monitor for signs of biopsychosocial concerns that may affect ability to communicate, such as delirium, anxiety and fear.

### **Associated Documentation**

- Communication Enhancement Strategies

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## **Device-Related Complication Risk (Mechanical Ventilation, Invasive)**

### **Signs/Symptoms/Presentation**

- air auscultated in stomach
- airflow out of mouth
- airway sounds increased
- breath sounds unequal
- chest movement asymmetrical
- difficulty passing suction catheter
- excessive cough
- gastric distension
- gurgling sound from throat
- inability to ventilate
- mechanical ventilation with an artificial airway
- no airflow from device
- restlessness
- upper airway sounds increased
- work of breathing increased

## Vital Signs

- heart rate increased
- respiratory rate increased
- SpO<sub>2</sub> (peripheral oxygen saturation) decreased
- EtCO<sub>2</sub> (end-tidal carbon dioxide) increased

## Laboratory Values

- PaCO<sub>2</sub> (arterial carbon dioxide) increased
- PaO<sub>2</sub> (partial pressure of arterial oxygen) decreased

## Diagnostic Results

- CXR (chest x-ray) confirmation of abnormal tube position
- EtCO<sub>2</sub> (end-tidal carbon dioxide) waveform abnormal
- obstruction visualized with bronchoscopy

- ultrasonography abnormal tube position

## Problem Intervention(s)

### Optimize Device Care and Function

- Maintain semirecumbent position to minimize aspiration risk.
- Provide oral care regularly with antimicrobial solution and subglottic suction to reduce the risk of infection; perform prior to cuff deflation.
- Assess tube size, depth, location and securement frequently to minimize the risk of tube displacement; regularly confirm placement with radiography or ultrasonography.
- Facilitate regular mechanical ventilator and humidification equipment checks to ensure proper function; monitor and manage ventilator and alarm settings.
- Provide humidification and evaluate need for suctioning to minimize risk of airway obstruction; regularly replace closed in-line suction equipment.
- Perform ongoing tracheostomy and stoma care to prevent infection; minimize excessive moisture around device ; replace or clean inner cannula or tracheostomy regularly to prevent obstruction from secretions.
- Monitor and manage cuff pressure routinely, if present; deflate cuff when not clinically indicated.
- Provide emergency equipment that includes appropriate-sized manual resuscitation bag, mask, suction equipment and cleaning supplies; replace device or assist breathing if displacement occurs.

### Associated Documentation

- Airway Safety Measures
- Aspiration Precautions

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## Inability to Wean (Mechanical Ventilation, Invasive)

### Signs/Symptoms/Presentation

- confusion
- continued need for mechanical ventilation
- disconnected from reality

- fear
- inability to decrease ventilator settings
- increase in oxygenation or ventilation requirements
- level of consciousness decreased
- lung compliance decreased
- muscle weakness
- positive fluid balance
- respiratory effort absent
- unable to follow commands

## Vital Signs

- heart rate increased
- respiratory rate increased
- blood pressure increased or decreased
- SpO<sub>2</sub> (peripheral oxygen saturation) decreased
- EtCO<sub>2</sub> (end-tidal carbon dioxide) increased

## Laboratory Values

- ABG (arterial blood gas) abnormal

## Problem Intervention(s)

### **Promote Extubation and Mechanical Ventilation Liberation**

- Assess for pain and agitation regularly, utilizing a validated tool; minimize medication effects that may contribute to agitation, delirium or delay extubation.
- Encourage early rehabilitation using therapeutic intervention and functional mobility training to minimize deconditioning, weakness, functional dependence and delirium.
- Assess readiness to wake up, breathe, wean and extubate; consider protocol approach to reduce ventilator and intensive care days.
- Perform SBT (spontaneous breathing trial).

- Facilitate clustered care and uninterrupted sleep/rest pattern that supports home sleep routine; promote calm environment.
- Acknowledge fear and anxiety related to the patient's and support system's experience of prolonged mechanical ventilation; encourage complementary therapies, such as music and playtime.

### Associated Documentation

- Environmental Support
  - Medication Review/Management
  - Sleep/Rest Enhancement
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## Nutrition Impairment (Mechanical Ventilation, Invasive)

### Signs/Symptoms/Presentation

- inability to intake nutrition via oral route

### Problem Intervention(s)

#### Optimize Nutrition Delivery

- Perform a nutritional assessment; include a nutrition-focused physical exam.
- Determine calorie, protein, vitamin, mineral and fluid requirements; use indirect calorimetry if nutrition support is required.
- Initiate early enteral nutrition support; consider another form of stress ulcer prophylaxis, if enteral feeding is contraindicated.
- Optimize protein intake, unless contraindicated.
- Consider postpyloric versus gastric tube feeding for patient at increased risk of aspiration.
- Advocate for, and adjust, infusion rate, formulation or volume based on feeding tolerance and clinical status (e.g., hemodynamic stability); minimize unnecessary interruptions.
- Anticipate the need for a promotility agent, if reduced gastric emptying or delayed bowel motility is suspected.
- Monitor nutrition delivery to ensure safe practices (e.g., confirmation of tube placement, tube patency, medication delivery, head of bed elevation, oral care).

## Associated Documentation

- Nutrition Support Management
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# Skin and Tissue Injury (Mechanical Ventilation, Invasive)

## Signs/Symptoms/Presentation

- bleeding
- laceration
- localized swelling
- redness
- skin blanching
- skin integrity disrupted
- stoma granulation
- stridor
- tracheal granuloma
- voice hoarse

## Problem Intervention(s)

### Maintain Skin and Tissue Health

- Monitor depth of suction catheter advancement to minimize the risk of internal tracheobronchial tissue injury.
- Reposition and resecure endotracheal tube regularly; ensure proper tube location.
- Monitor tightness of securement device, as well as skin and mucosal areas, regularly; consider skin barrier protection.
- Minimize pressure points and prevent traction on device, using careful positioning, flexible extenders and props.
- Assess and monitor for the presence of bleeding that may indicate injury to tracheobronchial tissue. Notify provider for persistent bleeding.
- Anticipate the need for further treatment or procedure, if bleeding persists.
- Anticipate adjunct therapy, such as cool mist, racemic epinephrine, corticosteroid or heliox, for symptoms related to airway swelling or stridor after removal of tube.



## Associated Documentation

- Device Skin Pressure Protection
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# Ventilator-Induced Lung Injury (Mechanical Ventilation, Invasive)

## Signs/Symptoms/Presentation

- lung compliance decreasing
- oxygenation requirements increasing (e.g., FiO<sub>2</sub> or positive end expiratory pressure needs)
- ventilatory requirements increasing (e.g., minute volume, respiratory rate)

## Vital Signs

- heart rate increased
- respiratory rate increased
- blood pressure increased or decreased
- SpO<sub>2</sub> (peripheral oxygen saturation) decreased
- EtCO<sub>2</sub> (end-tidal carbon dioxide) increased

## Laboratory Values

- oxygen index decreased
- PaCO<sub>2</sub> (arterial carbon dioxide) increased
- PaO<sub>2</sub> (partial pressure of arterial oxygen) decreased

## Diagnostic Results

- bronchoscopy abnormal
- CXR (chest x-ray) abnormal

## Problem Intervention(s)

### Facilitate Lung-Protection Measures

- Provide oxygen therapy judiciously to maintain oxygenation goals; adjust to avoid hyperoxia.
- Monitor and limit ventilator tidal volumes to minimize volutrauma; initiate low tidal-volume strategy (e.g., less than 8 mL/kg for ideal body weight).
- Monitor and limit ventilator pressure to reduce risk of barotrauma; maintain less than 30cm H<sub>2</sub>O (e.g., plateau, inspiratory pressure delta).
- Apply PEEP (positive end expiratory pressure) to minimize atelectasis; adjust for changes in lung compliance and oxygenation.
- Monitor fluid balance closely to minimize the risk of fluid overload.
- Monitor ventilator waveforms and promote patient-ventilator synchrony; adjust ventilator settings and sedation.

### Prevent Ventilator-Associated Pneumonia

- Assess readiness to extubate; perform sedation interruption and spontaneous breathing trial.
- Maintain semirecumbent position to minimize aspiration risk.
- Provide ongoing oral care to reduce pathogens in oral cavity; anticipate antiseptic oral decontamination.
- Minimize ventilator circuit breaks; consider use of closed suction device.
- Minimize microaspiration risk; consider the use of ultrathin polyurethane tapered endotracheal tubes with subglottic secretion drainage, as well as cuff pressure monitoring.
- Assess need for stress ulcer and venous thromboembolism prophylaxis due to increased risk during mechanical ventilation.

### Associated Documentation

- Lung Protection Measures

### Associated Documentation

- Head of Bed (HOB) Positioning
- Oral Care
- VAP Prevention Bundle

## General Education

- admission, transition of care
  - orientation to care setting, routine
  - advance care planning
  - diagnostic tests/procedures
  - opioid medication management
  - oral health
  - medication management
  - pain assessment process
  - safe medication disposal
  - tobacco use, smoke exposure
  - treatment plan
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## Safety Education

- call light use
  - equipment/home supplies
  - fall prevention
  - harm prevention
  - infection prevention
  - MDRO (multidrug-resistant organism) care
  - personal health information
  - resources for support
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## Education: Mechanical Ventilation, Invasive: Overview

- description
  - indications
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## Education: Mechanical Ventilation, Invasive: Self-Management

- CPR education
  - VAP prevention
  - VTE prevention
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## Education: Mechanical Ventilation, Invasive: When to Seek Medical Attention

- unresolved/worsening symptoms
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