

NURSING CLINICAL STANDARD

MECHANICAL VENTILATION - ICU

PURPOSE: To outline the management of intubated patients during mechanical ventilation and immediate post extubation period.

SUPPORTIVE DATA: The weaning section of this protocol is NOT indicated for terminal weaning.

The respiratory care practitioner (RCP) is responsible for:

- Initial ventilator setup (per provider order)
- Changes in settings (per provider order)
- Maintaining respiratory equipment
- Performing spontaneous breathing trials (SBT) per policy
- Extubation per provider order

Ventilator associated pneumonia (VAP) is a serious complication of mechanical ventilation. Measures to decrease the incidence of VAP and other ventilator related complications include the following aspects:

- Hand hygiene
- Elevation of head of bed/ Proper patient positioning
- Early mobility
- Oral/ nasopharyngeal care
- Adequate artificial airway clearance
- Daily Spontaneous Awakening Trial (SAT)/ Daily Awakening Trial “sedation vacation” (Adults only) and assessment of readiness to wean
- Peptic ulcer prophylaxis (Adults only)
- Deep vein thrombosis / Venous thromboembolism prophylaxis (Adults only)

Sputum gram stain, culture & sensitivity specimens from adult patients on mechanical ventilation are to be obtained by the RCP via mini-BAL (bronchial alveolar lavage) as ordered, rather than by a standard suction catheter and lukens sputum trap.

For NICU patients, see Mechanical Ventilation – NICU Nursing Clinical Standard.

Prior to extubation, a cuff leak test is done by a Respiratory Care Practitioner to ensure absence of laryngeal edema. This assessment is performed by deflating the cuff and then listening for air movement around the ETT using a stethoscope placed over the upper trachea. For adults, after deflating the cuff, exhaled tidal volume measured on the ventilator should not be more than 70% of the delivered tidal volume. Lack of leak (by auscultation and/or percent on ventilator) would prompt a careful consideration of extubation.

ASSESSMENT:

1. Assess the following a minimum of every 2 hours:
 - Vital signs (VS)
 - Oxygen saturation via pulse oximeter
 - End tidal CO₂ (pediatrics only)
 - Signs/symptoms (S/S) respiratory distress:
 - Use of accessory muscles
 - Retractions
 - Nasal flaring

2. Assess the following a minimum of every 4 hours during mechanical ventilation (then post extubation per unit Physiologic Monitoring/Hygiene/Comfort Nursing Clinical Standards):
 - Respiratory pattern
 - Breath sounds
 - Symmetrical chest expansion
 - Secretions: quantity, color, character, odor
 - Cough
3. Assess the following a minimum of every 4 hours (pediatrics: every 2 hours):
 - Ventilator settings
 - Tidal volume (V_T)
 - F_iO_2 (% oxygen)
 - Mode, rate
 - Positive end expiratory pressure (PEEP) / Continuous Positive Airway pressure (CPAP)
 - Pressure support (PS)
 - Peak inspiratory pressure (PIP)
4. Evaluate arterial blood gases (ABG), or venous blood gases (VBG) results when drawn:
 - Blood gases should not be drawn sooner than 20 minutes post setting change/suctioning.

ADMINISTRATION:

5. Ensure ventilator settings match provider's order.

VAP PREVENTION:

6. Provide mouth care:
 - Use suction toothbrush kit every 12 hours
 - Use foam sponge dipped in chlorhexidine to cleanse mouth every 12 hours (patients greater than 2 years of age only)
 - Use suction swab a minimum of every 4 hours to clean mouth and suction secretions from back of mouth in between toothbrush kit use
7. Reposition patient every 2 hours to optimize ventilation and mobilize secretions unless contraindicated.
8. Maintain head of bed (HOB) at greater than or equal to 30 degrees unless contraindicated.

SAFETY:

9. Collaborate with RCP to ensure alarms are audible at all times.
10. Maintain bag-valve-mask (B-V-M) and oxygen source at bedside at all times.
11. Ensure tubing and condensation traps are empty.
12. Apply restraints/mittens as ordered to prevent self-extubation.
13. Wear gown and gloves for direct contact for all pediatric patients with artificial airways.
14. Retape and reposition ETT per Artificial Airway – ICU Standard.

SEDATION:

15. Administer /titrate sedation as ordered for:
 - Provider specified Richmond Agitation Sedation Scale (RASS) (adults only)
 - Agitation/increased respiratory rate not related to hypoxia
 - Unresolved high-pressure alarm after troubleshooting
16. Hold/ titrate down sedation as ordered for SAT and SBT/ CPAP trial.
17. Instruct on the following:
 - Purpose of mechanical ventilation
 - Machine alarms
 - Patient's inability to speak

PATIENT/CAREGIVER EDUCATION:

- Communication must be kept simple:
 - Ask questions that require only a "yes/no" response from patient
 - Flash card in patient's language with English translations
- The importance of prevention of VAP
 - Measures to prevent VAP
 - Hand hygiene

18. Notify provider of the following:
- Significant change in vital signs, blood gas results
 - Sustained hypoxia
 - Sustained increased PIP
 - Requirement for increase in FiO₂
 - Signs/symptoms of respiratory distress
 - Poor tolerance of SAT and SBT/ CPAP trial

REPORTABLE
CONDITIONS:

19. Report ventilator problems to the RCP:
- Whenever ventilator function is in doubt, remove patient from ventilator and manually ventilate with resuscitation bag with 100% oxygen.
20. Collaborate with RCP/Provider to assess readiness for extubation.
Consider the following as applicable:
- Results of SBT/ CPAP trial
 - Strength of cough/amount of secretions
 - Level of consciousness (alert and cooperative)
 - Blood gas results
 - Respiratory stability
 - Cardiovascular stability (stable BP off of or on minimal vasopressor dosage)
 - No major surgeries/procedures planned
 - Resolution/improvement of pathology that resulted in intubation
 - Nutritional status
 - Weaning criteria (Adults only - see Table)
 - Endotracheal tube leak test
 - Note: Optimally extubation should **NOT** be done at night

WEANING/
EXTUBATION:

21. Explain weaning process to patient/ family:
- Purpose of SBT/ CPAP trial
 - SBT/ CPAP trial procedure
 - Extubation procedure
 - Need for frequent VS before and after extubation
 - Positioning
 - Importance of coughing and deep breathing post-extubation
22. Ensure oxygen delivery system and suction is set up prior to extubation.
23. Assess respiratory pattern, breath sounds, and obtain vital signs including SpO₂ pre-extubation.
24. Monitor SpO₂ and respiratory status (e.g. for stridor, difficulty breathing, chest-abdominal asynchrony) immediately post-extubation and continuously for a minimum of 15 minutes.
25. Assess VS immediately post-extubation and at the following intervals:
- Within 10 minutes post-extubation then
 - A minimum of hourly for 4 hours then
 - A minimum of every 2 hours until transfer to acute care unit
26. Obtain blood gas post-extubation as ordered.

ADDITIONAL STANDARDS:

- 27. Implement the Artificial Airway -ICU Standard in conjunction with this standard.
- 28. Implement the following as indicated:
 - Enteral Feeding
 - Intravenous Therapy
 - Immobility
 - Nasal Gastric Intubation for Decompression
 - Neuromuscular Blocking Agents - ICU
 - Restraints
 - Sedation & Analgesia (Intravenous) - ICU
 - Mechanical Ventilation, Alternative Modes - ICU
 - Verbal Communication, Impaired

DOCUMENTATION:

- 29. Document in accordance with documentation standards on ICU Systems Assessment, Mechanical Ventilation, Artificial Airway Breath Sounds Assessment, and Respiratory sections.
- 30. Document Safety screen for SAT, and SAT via Task List.
- 31. Document head of bed elevation and oral care on ICU Quick View, Activities of Daily Living section.

WEANING CRITERIA – ADULTS			
Parameter	Definition	Significance	Normal Values
Rapid Shallow Breathing Index (RSBI)	Calculation: Spontaneous Respiratory/ Rate /Spontaneous Tidal Volume	If > 105 recommend do not extubate	60-105
NIF	Negative Inspiratory Force as measured by Inspiratory Force Manometer or ventilator	Indicates ability to take a deep breath and generate strong cough	greater than -20 cmH ₂ O
Respiratory Rate	Spontaneous breaths per minute	High rate indicates increased work of breathing	less than 30 Range 12 to 30
PEEP	Positive end expiratory pressure Physiologic PEEP is 5 cmH ₂ O	PEEP less than 5 cm indicates improvement in oxygenation	less than or equal 5 cm H ₂ O
Spontaneous Tidal Volume (V _T)	Amount of volume inhaled with each breath	Indicates enough air movement for adequate gas exchange	greater than 300 ml (greater than 5 ml/kg)
Spontaneous Vital Capacity (VC)	Volume of air exhaled after a maximum inspiration without using force	Adequate VC prevents atelectasis and ensures adequate gas exchange	greater than 10-15 ml/kg
Spontaneous Minute Volume (V _E)	Spontaneous breaths per minute x V _T	High V _E is associated with respiratory muscle fatigue and increased work of breathing	5-10 L/min

Initial date approved: 8/93	Reviewed and approved by: Critical Care Committee Professional Practice Committee Nurse Executive Council Attending Staff Association Executive Committee	Revision Date: 11/94, 10/97, 4/00, 11/00, 03/05, 6/10, 4/12, 03/16, 12/21
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Consult: LAC+USC Epidemiology

Consult: LAC+USC ICU nursing

Consult: LAC+USC Respiratory Care Department