

UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation	Policy 7.3.53 Page 1 of 5
Mechanical Ventilation Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23

Mechanical Ventilation

Purpose

Mechanical Artificial Ventilation refers to any methods to deliver volumes of gas into a patient's lungs over an extended period to remove metabolically produced carbon dioxide. It is used to provide the pulmonary system with the mechanical power to maintain physiologic ventilation, to manipulate the ventilatory pattern and airway pressures for purposes of improving the efficiency of ventilation and/or oxygenation, and to decrease myocardial work by decreasing the work of breathing. Additionally, to describe guidelines or protocol, goals of therapy, appropriately functioning ventilation, circuit, patient interface, and proper setting of alarms perimeters.

Scope

Outlines the procedure of instituting mechanical ventilation and monitoring.

Accountability

- Mechanical Ventilation may be instituted by a qualified licensed Respiratory Care Practitioner (RCP).
 - To be qualified the practitioner must complete a competency-based assessment of ventilators being utilized on the campus they are working.
 - The RCP will have an understanding of the age-specific requirements of the patient.
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Physician's Order

Initial orders for therapy must include a mode (i.e. mandatory Ventilation/Assist/Control, pressure control etc., a Rate, a Tidal Volume, and an Oxygen concentration and should include a desired level of Positive End Expiratory Pressure, and Pressure Support if applicable.

Pressure modes will include inspiratory time and level of pressure control.

In the absence of a complete follow up order reflecting new ventilator changes, the original ventilator settings will be maintained in compliance with last order until provider is contacted and the order is clarified.

Indications

Mechanical Ventilation is generally indicated in cases of acute alveolar hypoventilation due to any cause, acute respiratory failure due to any cause, and as a prophylactic post-op in certain patients.

If a patient's spontaneous ventilation is clinically adequate, mechanical ventilation may not be indicated.

UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation	Policy 7.3.53 Page 2 of 5
Mechanical Ventilation Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23

Procedure

Step	Action
1	Verify provider order.
2	Set up ventilator with an appropriate circuit based on patient requirements (neonatal, pediatric, or adult).
3	Check ventilator for proper operation of all systems according to manufacturer recommendations: <ul style="list-style-type: none"> • No leaks in circuit. • Pre use check • Humidifier • Refer to policy 7.4.11. • Alarms functional and audible
4	Make sure proper size of resuscitator bag and mask are at bedside attached to O ₂ source.
5	Explain procedure to patient or family if possible.
6	Connect circuit to patient airway and monitor patient and ventilator to assure adequate ventilator and patient tolerance.
7	Complete a patient assessment within 30 minutes of initiation of mechanical ventilation, following any adjustments, following return of the patient from transport or transfer of care from another area or hospital and document results in EPIC.
8	A shift safety check is completed at the initiation and beginning of each shift to verify the mechanical ventilator is functioning correctly and emergency supplies are available at the bed side.
9	Circuits will be changed as needed in adult patients and every fourteen days in neonatal and pediatric patients.
10	The RCP is responsible for managing their workload and timing of at minimum 2 patient ventilator assessments per shift.
11	Patient ventilator assessments include but not limited to <ol style="list-style-type: none"> 1. Verification of ventilator orders to ventilator settings and mode of ventilation 2. Ventilation measurements 3. Ventilator limits and alarms 4. Airway assessment

Continued next page

UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation		Policy 7.3.53 Page 3 of 5
Mechanical Ventilation	Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23
	5. Respiratory assessment 6. Assessment of suction needs	

Undesirable Side Effects

The complications of Mechanical Ventilation can be placed into Five categories:

Ventilator Induced Lung Injury (VILI)

Barotrauma

- Tension Pneumothorax
- Pulmonary Interstitial Emphysema
- Pneumomediastinum
- Pneumopericardium
- Pneumoperitoneum

Volutrauma

- Parenchymal damage
- Increase permeability of alveolar membrane
- Edema
- Disruption in surfactant production
- Decreased compliance

Atelectrauma

- High shear forces caused by opening and closing of lung units that cause angular deformation of alveolar units

Biotrauma

- Extra pulmonary organ injury from pro injurious inflammatory response to mechanical lung injury
- Removal of natural defense mechanisms with intubation
- Contamination of vent circuits
- Contamination through suctioning

Cardiovascular effect

- Decrease venous return
- Decreased cardiac output
- Increased pulmonary vascular resistance

UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation	Policy 7.3.53 Page 4 of 5
Mechanical Ventilation Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23

Psychological Effects

- Inability to communicate (See Patient Teaching)
- Psychological dependency on ventilator

Assessment of outcomes

- Chest X-Rays
- Auscultation
- Work of Breathing Evaluation
- Sputum: culture, amount, color, consistency
- Patient Temperature
- Arterial and mixed venous blood gas values
- Pulmonary function studies
- Airway assessment
- Respiratory assessment
- Exhaled CO₂ (ETCO₂/VCO₂)
- Transcutaneous oxygen saturations
- Pulmonary mechanics (compliance, resistance, delta pressure)

Documentation

The RCP will assess and document current ventilator setting as indicated by ventilator mode type:

- Mode of ventilation
- Setting and Measured Ventilation
 - Ventilator frequency
 - Total respiratory rate (spontaneous plus set rate)
 - Tidal volume
 - Minute Ventilation
 - Inspiratory Time
 - PEEP level
 - PIP
 - MAP
 - PS (if applicable)
 - PS level
 - Termination sensitivity
 - Trigger
 - Rise time/ ramp to pressure

UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation	Policy 7.3.53 Page 5 of 5
Mechanical Ventilation Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23

- Extra monitoring (if applicable)
 - Edi
 - ETCO2
 - VCO2
 - TCM
 - Transpulmonary pressure

Patient/ Patients on mechanical ventilators require considerable emotional support.

Family Teaching

Step	Action
1	Explain the reason that for receiving mechanical ventilation. Relate it to disease or injury state.
2	Encourage patient to relax and allow the ventilator to work for the patient.
3	Explain the alarms and their function. Reinforce to patient that the alarms do not mean that the ventilator is not working, but that the ventilator needs some readjustment so that breathing will be easier.
4	Use reality orientation technique with patient (ask what day it is, what time it is, etc. (Inform patient if not known). Try to locate a clock that patient can see.
5	Teach patient communication techniques. It is very frustrating for a patient not to be able to communicate. Have the patient answer questions yes or no by shaking/nodding head. Provide patient with a tablet and pen for writing. If patient cannot write, draw the alphabet on a piece of paper or cardboard for spelling out communication by pointing to the letters. Above all let patient know that some kind of communication will be provided.

UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation	Policy 7.3.53 Page 6 of 5
Mechanical Ventilation Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23

Infection Control Follow procedures outlined in Healthcare Epidemiology Policies and Procedures #2.24; Respiratory Care Services.
<http://www.utmb.edu/policy/hcepidem/search/02-24.pdf>

Safety

Alarms

Alarms or alerts are designed to notify healthcare providers of a potential problem or issue that needs to be addressed. Mechanical ventilation alarms are particularly important as mechanical ventilation therapy is a life sustaining intervention. Inappropriate setting of all available alarms and setting them too tight can lead over alerting and alarm fatigue. Underutilization of alarms can lead to patient harm from missed opportunities to intervene. Appropriate alerting and response can prevent an adverse event. Alarms parameters can be adjusted by the RCP based on the patient's clinical condition, with a goal of setting the minimum number of alarms.

Required alarms:

1. The RCP will verify that all appropriate alarm parameters are set appropriately and are active.
2. Low inspiratory pressure/disconnect are typically manufacturer pre-set, but if available the RCP will set to the lowest setting without turning the alarm off.
3. High inspiratory pressure will be set 10-15 cmH₂O above the patient's average measured peak inspiratory pressure. Alarms set above 40 cmH₂O require a discussion with the Provider.
4. Low minute ventilation is set at 50% of the patient's average minute ventilation.
5. High minute ventilation is set at 200% of patient's average minute ventilation.
6. High frequency oscillatory ventilation (HFOV), the high and low MAP airway pressure will be set 5 cmH₂O above and below the ordered MAP.
7. Apnea alarms are to be set at a max of:
 - a. Neonates: 30 seconds
 - b. Peds/Adults: 45 seconds

*Optional Alarms

Optional alarms can be selected and set by the RCP

ETCO₂ – 10-15 mmHg above average ETCO₂

1. Tidal volume – 4 mL/Kg above and below the ordered or average tidal volume
2. High respiratory rate:
 - a. Neonates: Thirty (30) above the average RR
 - b. Peds/Adults: Twenty (20) above the average RR

UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation	Policy 7.3.53 Page 7 of 5
Mechanical Ventilation Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23

For patient safety reasons high priority alarms are never turned off. In certain instances the exhaled minute ventilation in the presence of a significant leak can be turned off as long as the disconnect alarm is still functional.

Infection Prevention

1. All ventilator surfaces are wiped down once a shift with hospital and ventilator approved antibacterial wipes.
2. Upon discontinuation of mechanical ventilation:
 - a. All disposables are to be removed and disposed of
 - b. Ventilator will be wiped down with hospital approved antibacterial wipes, Covered and taken to soiled equipment storage area.
 - c. Ventilator will be cleaned a second time according to manufacturer recommendation and moved to a clean room for set-up.
3. Condensation in the ventilation circuit will be treated as infectious waste and disposed of as needed while wearing the appropriate personal protective equipment (PPE).
4. Ventilator circuits will be changed when visibly soiled or malfunctioning.
5. Inspiratory limb filters will be changed as needed.
6. Expiratory limb filters (prior to the ventilator) will be changed daily and PRN. Internal and heated large volume expiratory filters will be changed according to manufacturer recommendations.

Correspond- Respiratory Care Services Policy # 7.4.11; Operating Instructions For Adult **ing Policies** Microprocessor Controlled Ventilators

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UTMB RESPIRATORY CARE SERVICES PROCEDURE - Mechanical Ventilation	Policy 7.3.53 Page 8 of 5
Mechanical Ventilation Formulated: 11/78	Effective: 10/26/95 Revised: 08/21/23 Reviewed: 08/21/23

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