Craig Hospital
Redefining Possible for People with Spinal Cord and Brain Injuries

Provided as a courtesy of
Craig Hospital
3425 South Clarkson St.
Englewood, Colorado 80113

www.craighospital.org
For more information:
Craig Hospital Nurse Advice Line
1-800-247-0257

MECHANICAL VENTILATION

What is Mechanical Ventilation?

A device that breathes for someone who is unable to breathe for themselves.

Why is a Ventilator Needed?

Brain and Spinal Cord Injury or Disease:

An injury or disease to the brain can interfere with the signals that control breathing. Damage to the spinal cord can block the brain's signals from reaching the breathing muscles.

Disorders of the Muscles:

Can weaken the breathing muscles or change the way in which they receive signals from the brain. This can happen with polio, ALS, and muscular dystrophy.

Lung Disorders:

Affect the tissues of the lungs making it difficult for a person to breathe on their own. These disorders include COPD, asthma, chronic bronchitis, emphysema, interstitial, or fibrotic lung disease.

Sleep Disorders:

Sleep apnea is a condition in which people stop breathing during sleep. These patients may use a form of ventilation only while sleeping called CPAP or BiPAP.

How Does it Work?

Mechanical ventilation is different from how we naturally breathe. During natural inhalation, the diaphragm muscle contracts and the chest expands. This creates a vacuum that pulls air into the lungs. During a natural exhalation, the diaphragm muscle relaxes and air leaves the lungs

A ventilator works by pushing air into the lungs. The air is pushed in until it reaches a pre-set volume or pre-set pressure. Once the lungs are full, the vent stops pushing the air into the lungs. The air then passively leaves the lungs. This is similar to letting air out of a full balloon.

Rev. 5/2016 Publication #863

Settings are selected when a patient is placed on a ventilator. These settings are different for every patient depending on their needs. They are chosen by a Pulmonologist but managed and monitored by a Respiratory Therapist.

Ventilator Modes: how the ventilator is programed to deliver a breath.

a. Controlled: The ventilator ***provides*** the breath when a patient is unable to breathe on their own.

b. Supported: The patient is able to breathe on-their-own but needs a little help. The ventilator will provide a small amount of pressure to increase the size of their natural breath.

c. Combination: A combination of controlled and supported breathing that fine-tunes the breath.

The ventilator will deliver the breath in 2 different ways:

1. Volume: The ventilator delivers a pre-set volume of air with every breath.
2. *Pressure: The ventilator will deliver a breath until a pre-set pressure is reached.*

Ventilator Settings

1. ***Oxygen concentration:*** The amount of oxygen delivered to the patient. When the patient is **not** receiving added oxygen, the oxygen level will be the same as room air (21%).
2. **Tidal volume (Vt):** The amount of air the vent delivers with each breath.
3. **Respiratory rate:** The number of breaths the ventilator is delivering to the patient per minute.
4. **Pressure:** The pre-set pressure the ventilator uses to create a volume of air.
5. **Inspiratory time/Flow:** Controls how long the patient inhales. The goal is to simulate a normal breathing pattern.
6. **Dead Space:** Additional tubing in the vent circuit that traps exhaled carbon dioxide (CO2) when a patient exhales. CO2 affects the pH balance in the bloodstream. The respiratory therapist will add or subtract tubing from the ventilator circuit to adjust CO2 levels and keep them within normal limits.
7. **PEEP:** (Positive end-expiratory pressure) adds a small amount of back pressure as the patient exhales that helps keep the lungs open.
8. **Sensitivity or Trigger:** Controls how hard or how easy the patient will need to inhale to signal the vent that they would like additional breaths **above the set** respiratory rate.

Ventilator and Patient Monitoring

Patient monitoring and ventilator checks are generally performed every 4 hours in the hospital. This is important to guarantee proper ventilator function and to know if there is a patient issue. Such as:

- the patient needs suctioning
- the patient needs a breathing treatment
- the equipment is functioning properly
- it also helps protect against accidental changes that may occur with the controls

The following are examples of some of the information monitored by the Respiratory Therapist

1. **End-Tidal Volume (Vte):** Is the amount of air the patient's lungs return to the ventilator with exhalation.
2. **Total Respiratory Rate:** This includes breaths delivered by the ventilator and if they are able to breath on their own, the patient's natural breaths.
3. **Peak Inspiratory Pressure (PIP):** Represents the highest amount of pressure in the chest and in the ventilator circuit when the lungs are filled with air.
4. **Oxygen Levels:** Is the oxygen level in the blood. A device called a pulse oximeter reads this.
5. **Breath Sounds:** The sounds a patient's lungs make while breathing. You can usually hear a rumbling or diminished breath sounds when a patient needs to be suctioned. You can also feel the patient's chest for the vibration of the rumble.
6. **Breathing Effort:** Does your patient appear to be struggling while breathing? Always check your oxygen and need for suction first. If this doesn't do the trick, call for your Respiratory Therapist.

Rev. 5/2016 Publication # 863

Alarms

The ventilator is equipped with safety alarms. An alarm will sound if the ventilator exceeds or drops below certain limits. Always look at and attend to the patient first. Address the alarm situation second.

1. **Low pressure alarm:** Indicates that the pressure in the ventilator circuit has dropped. Low pressure alarms are usually caused by a leak or disconnect. Start at the patient and work your way towards the vent checking for loose connections. This can also include a leak at the site where the tracheostomy tube enters the neck. If they are struggling for air, disconnect the circuit from the patient and manually ventilate with a resuscitation bag (AMbu bag). Then call for help.
2. **Low Minute Ventilation (Ve):** This alarm will sound when the amount of air taken in per-minute drops below a set value. It will act similar to a low pressure alarm and usually indicates some kind of a leak or disconnect in the system.
3. **High pressure alarm:** This will sound when the pressure in the circuit has increased. It helps protect the lungs from high pressures delivered from the ventilator. Secretions, water in the tubing, or kinks in the tubing can cause high pressure. Suction the patient and look for other sources. If this does not fix the problem, disconnect the patient from the circuit and manually ventilate with an AMbu bag. Then call for help.

Moisture and Humidification

It is important to heat and humidify the air delivered from a ventilator. Dry, cold air can damage the delicate tissues of the airways and cause mucus plugs. Heat and humidity can be delivered in 2 different ways:

1. **HME:** (heat moisture exchangers): Small filter type device placed in the vent circuit that captures the heat and moister exhaled from the patient's own breath. It stores it in the filter and then returns it to the patient with the next inhaled breath.
2. **Heated Humidifier:** An external heated humidifier that attaches to the ventilator. The humidifier temperature should be similar to body temperature 98.6°F or 37°C. Condensation can collect in the tubing and should be removed by draining the water.

Infection Control

In order to reduce the chance of infection:

1. **Wear Gloves** – When touching the ventilator circuit or trach tube.
2. **Wash your hands** – Before and after contact with the patient.
3. **Wear a mask** – If the patient has a contagious respiratory disease or if you are sick and could infect the patient.

Safety Precautions

1. Use all equipment safely.
2. Do not store liquids on top of the ventilator.
3. In the hospital, the ventilator will always be plugged into a red electrical outlet. If the hospital loses power, the red outlets are connected to a backup generator.

Wheelchair Charging Considerations

Power wheelchairs run the ventilator while the patient is in their wheelchair. The chair and the ventilator should be charged when the patient is not using them and on a nightly basis. Your Occupational Therapist along with your Respiratory Therapist will train you how to charge the wheelchair and ventilator.

Rev. 5/2016 Publication # 863