Objectives

- Understand the premise & main indications for mechanical ventilation
- Obtain/interpret information on settings & patient performance from ventilator screen
- Become familiar with basic ventilator terminology & modes
- Identify PT treatment indications for mechanically ventilated & weaning patients
Why not wait until the patient is extubated?

- Muscle Strength decreases 1.3-3% for each day the healthy individual spends on bedrest (Topp, et al. 2002)

- Effects are even more profound in older individuals & those with critical illness (Yende, et al. 2006)
Ventilation

Ventilation is the process by which gases are moved in & out of the lungs

Spontaneous Ventilation is a result of negative intrathoracic pressure being created by the inspiratory muscles

- Muscles contract & pull on pleura
- Pressure in the intrapleural space decreases
- Negative pressure gradient pulls air from the atmosphere into the lungs
Mechanical Ventilation

- *Mechanical Ventilation* is the use of artificial means to support or replace spontaneous ventilation

- Mechanical Ventilation must satisfy a patient’s respiratory needs without:
  - Damaging the lungs
  - Impairing circulation
  - Causing patient discomfort
Indications

Mechanical Ventilation

**Hypoxemic Respiratory Failure**
- Inadequate Gas Exchange
- Decrease in PaO2
- Inability to maintain % oxygen saturation
  - Hypoventilation
  - V/Q mis-match
  - Diffusion Impairment

**Hypercapnic Respiratory Failure**
- Increase in PaCO2
- Inability to ventilate
  - Respiratory muscle fatigue
  - Neuromuscular disorders
  - CNS depression
  - Musculoskeletal disorders
Indications for Mechanical Ventilation

- **Airway Protection**
  - Preventative Measure

- **Cardiac Arrest**
  - Life-saving measure

- **Management of ICP**
  - Creation of alkalosis --> vasoconstriction --> decreased cerebral blood flow/reduction of ICP

- **Airway Obstruction**
  - Maintenance of patent airway

- **Surgery or Trauma**
  - General Anesthesia
Delivery

- Endotracheal Tube
- Nasal Endotracheal Tube
- Tracheostomy
Key Units of Measurement

- **Volume**
  - mL

- **Pressure**
  - cmH2O

- **Flow**
  - L/min

- **Rate**
  - Breaths/min

- **FiO2**
  - %
Types of Mechanical Ventilation

**Pressure Ventilation**
- **Negative pressure ventilation**
  - Iron Lung
  - Chest Cuirass
- **Positive pressure ventilation**
  - The application of positive pressure to the lungs to improve gas exchange
  - The opposite of natural “spontaneous breathing”

**Volume Ventilation**
- The application of supplemental volume to the lungs to improve gas exchange
Screen Organization

Patient Performance Data

Clinician Entered Settings
Modes: **Assist-Control**

- Full Ventilatory Support
  - Mandatory breaths delivered at set parameters
    - Rate
    - Inspiratory Pressure or Volume
    - FiO2
    - PEEP

- Ventilator will also support any patient-triggered breaths at these set parameters
Assist-Control Settings View

- **Mode**
  - Pressure Control (PC)

- **Rate (f)**

- **Inspiratory Pressure (Pi)**

- **FiO2 (O2 %)**

- **PEEP**
Assist-Control
Performance Data View

- Type of Breath Delivered (A or C)
- Respiratory Rate ($f_{TOT}$)
- Tidal Volume ($V_{TE}$)
Modes: **Spontaneous**

- All breaths are initiated & terminated by the patient.
- Ventilator assists the patient’s inspiratory efforts to
  - Over-come airway resistance
  - Augment tidal volumes
  - Decrease work of breathing

**Mode Settings**
- Pressure Support
- FiO2
- PEEP
Spontaneous Settings View

- **Mode**
  - Spontaneous (SPONT)

- **Pressure Support (PS)**

- **FiO2 (O2 %)**

- **PEEP**
Spontaneous Performance Data View

- Type of Breath Delivered (S)
- Respiratory Rate ($f_{TOT}$)
- Tidal Volume ($V_{TE}$)
PEEP

Positive End Expiratory Pressure

- Elevates baseline pressure at which inspiration is delivered
- Increases alveolar recruitment & surface area available for gas exchange
- Prevents alveolar collapse at end-expiration
Alarms

- **Red** Alarms
  - Circuit Disconnect
  - Apnea

- **Yellow** Alarms
  - Low Tidal Volume
  - High Respiratory Rate
  - High Pressure
Adverse Side-Effects
Prolonged Exposure to Mechanical Ventilation

- Impaired Circulation
- Decreased Cardiac Output
- Ventilator-Induced Lung Injury
- Respiratory Muscle Atrophy
- Barotrauma
- Ventilator-Associated Pneumonia
Application for Physical Therapists
PT Considerations

- **Call Respiratory Therapy**
  - For status update, notification, & assistance
  - Understand hospital policy

- **Schedule Assistant Time**

- **Monitor Patient Performance**
  - Top of ventilator screen
  - Vital signs

- **Suctioning Competency**
  - Ballard/Closed In-Line Suction
ET Tube Placement

- Placement indicator at level of teeth or lip
- Confirm placement with RT or RN before & after mobilization
Documentation

- **Assist-Control**
  - Mode
  - Inspiratory Pressure or Volume
  - Set Rate
  - FiO2
  - PEEP

- **Spontaneous**
  - Mode
  - Pressure Support
  - FiO2
  - PEEP
Ventilator Weaning

- Ventilatory discontinuance. The process of reducing ventilator support

- **Goal**: Restoration of pt.’s ability to independently & adequately ventilate without the mechanical ventilator

  - Changing the mode
  - Changing the settings
  - Trach collar trial/T-piece trial
Weaning Considerations

- **VO2 increases with all forms of exercise**
  - Increase in cardiac output
  - Increase O2 extraction across capillary beds

- **Spontaneous breathing trials**
  - Reduction of Ventilator support
  - Pressure Support/Trach Collar
  - Can increase cardiovascular work-load

- **Tailor treatments accordingly**
  - Monitor patient tolerance
  - Provide adequate rest periods

- **MORE vent support is BETTER**
  - For PT/OT during preliminary weaning trials
  - Exercise clinical judgement
Exercise Intolerance

In the setting of increasing workload...

- Increasing respiratory rate
- Decreasing tidal volumes
- Increasing accessory muscle use

Looks for the signs, know when to take a break!
Safety & Feasibility---The Evidence
Mobilization with Patients Receiving Mechanical Ventilation

- One study conducted 1,449 activity events in 103 mechanically ventilated patients.
  - Adverse activity-related events occurred in <1%
  - No patients were extubated during activity (Bailey, et al. 2007)

- Another study conducted PT & OT in 49 mechanically ventilated patients on a median of 1.5 days s/p intubation
  - Therapy was provided on 90% of MICU days
  - 89% of patients encountered had at least 1 potential barrier to mobilization in addition to mechanical ventilation
  - Therapy was interrupted prematurely in only 4% of all sessions (Pohlman, et al. 2010)
Evidence Continued

- Prospective, observational study
  - 179 mobilization therapies with 63 critically ill patients

- Patient level of mobilization achieved by Physical Therapists was significantly higher than that achieved by Registered Nurses  
  (Garzon-Serrano, et. al 2011)
Early Mobilization

- A strategy for whole-body rehabilitation---consisting of interruption of sedation & physical & occupational therapy in the earliest days of critical illness

  - Safe & effective
  - Better functional outcomes at hospital discharge
  - Shorter duration of delirium
  - More ventilator-free days compared with standard of care
  - Decreased length of hospital stay (Schweickert, et al. 2009)
References