Respiratory Care Devices and the RT Role in the Clinically Fragile Patient

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Objectives

- Describe different types of respiratory support, from low flow oxygen devices to ventilator management and weaning.

- Explain the process of spontaneous breathing trials.

- Explain respiratory therapists role in mobility of the clinically fragile patient.
The overall goal of oxygen therapy is to maintain adequate tissue oxygenation while minimizing cardiopulmonary work.

- correct documented or suspected acute hypoxemia
- decrease the symptoms associated with chronic hypoxemia
- decrease the workload hypoxemia imposes on the cardiopulmonary system
Humidified Devices

- Nasal Cannula
- High Flow Nasal Cannula
- Heated High Flow Nasal Cannula
- Trach Collar/T-tube
- Face Mask
- Face Tent
Nasal Cannula & High Flow Nasal Cannula
Heated High Flow Nasal Cannula

- Adjust and titrate flow and FiO2 for desired O2 Sats
- Indications:
  - Airway reactivity from cool aerosol devices
  - Patients requiring Fio2 > 40% or flow demand > 15lpm in which other devices will not meet their demands or comfort
  - Patients requiring high oxygen demands that have poor mask compliance
Trach Collar
T-piece
Face Mask & Face Tent

Non-Humidified Devices

- Venturi Mask
- Partial Rebreather Mask
- Non-Rebreather Mask
- Oxygenator
Oxygenator

Mechanical Ventilation

“The purpose of ventilation, whether spontaneous or artificial, is to help maintain normal respiratory balance or homeostasis.”
Goals of Mechanical Ventilation

- Support or manipulate pulmonary gas exchange
- Increased lung volume
- Reduce the work of breathing
- Reverse acute respiratory failure
- Reverse respiratory distress
- Reverse hypoxemia
- Prevent or reverse atelectasis and maintain FRC
- Reverse respiratory muscle fatigue
- Reduce systemic or myocardial oxygen consumption
- Minimize associated complications and reduce mortality
Non-Invasive Positive Pressure Ventilation

- Defined as “the application of positive of pressure via the upper airway tract for the purpose of augmenting the alveolar ventilation.”

- CPAP vs BiPAP
  - Continuous Positive Airway Pressure
    - Settings: PAP & FiO2
  - Bi-level Positive Airway Pressure
    - Settings: IPAP, EPAP & FiO2

- Interfaces
  - Full Face Mask
  - Face Mask
  - Nasal Mask
  - Nasal Prongs
Goals of NPPV

- **Chronic Care:**
  - Alleviates symptoms of chronic hypoventilation
  - Improves duration and quality of sleep
  - Improves functional capacity
  - Prolongs survival
  - Improves mobility

- **Acute Care:**
  - Reduces need for intubation
  - Reduces incidence of nosocomial pneumonia
  - Shortens stay in intensive care unit (decreases hospital length of stay)
  - Reduces mortality
  - Preserves airway defenses
  - Improves patient comfort
  - Reduces need for sedation
Indications of Non-Invasive Positive Pressure Ventilation

- Chronic Care:
  - Restrictive thoracic disease
  - Chronic obstructive pulmonary disease (COPD)
  - Nocturnal hypoventilation

- Acute Care:
  - COPD exacerbation
  - Asthma
  - Cardiogenic pulmonary edema
  - Hypoxemic respiratory failure
  - Community-acquired pneumonia
  - Immunocompromised patients
  - Postoperative patient
  - “Do not intubate” status
Contraindications of NPPV

- **Absolute:**
  - Respiratory arrest
  - Cardiac arrest
  - Upper airway obstruction
  - Inability to protect the airway or high risk of aspiration
  - Inability to clear secretions
  - Facial or head surgery or trauma

- **Relative:**
  - Cardiovascular instability
  - Uncooperative patient
  - Copious or viscous secretions
  - Fixed nasopharyngeal abnormalities
  - Extreme obesity
Indications of Invasive Ventilation

- Respiratory Arrest
- Cardiac Arrest
- Failure of NPPV
- Upper airway obstruction
- Respiratory failure (hypoxemic vs. hypercapnic)
- Inability to protect the airway or high risk of aspiration
- Non-respiratory organ failure
- Life threatening hypoxemia
- Severe acidosis
- Facial or head surgery or trauma
- Severe dyspnea with use of accessory muscles and possible paradoxical breathing
- Cardiovascular complications
Causes of Respiratory Failure

Hypoxemia
- ARDS
- Pulmonary embolism
- Pulmonary edema
- Septic shock
- Pulmonary infection (viral, bacterial, fungal)
- Inhalation (smoke, chemical, water)
- Pleural effusion
- Interstitial lung disease
- Obstructive lung disease
- Aspiration
- Primary pulmonary hypertension
Causes of Respiratory Failure

- **Hypercapnic**
  - **Decreased Ventilatory Drive**
    - Drug overdose, central sleep apnea, metabolic alkalosis, brainstem lesions, hypothyroidism, infection (encephalitis)
  - **Increased Work of Breathing**
    - COPD, asthma, obesity, pneumothorax, severe burns, kyposcoliosis, upper airway obstruction, pleural effusion, airway edema, infection
  - **Respiratory Muscle Fatigue**
    - Guillain-Barre Syndrome, ALS, Myasthenia gravis, Muscular dystrophy, SLE, phrenic nerve injury, botulism, spinal cord injury, muscular weakness, hypokalemia, hypophosphatemia, hypomagnesemia, hypocalcemia
Invasive Mechanical Ventilation

- Interfaces
  - Endotracheal Tube
    - Oral pharynx
    - Nasal pharynx
  - Tracheostomy Tube
Ventilator Settings

- f – Frequency/Rate of breaths per minute
- VT – Tidal Volume delivered
- PC – Pressure Control
- PEEP – Positive End Expiratory Pressure
- PS – Pressure Support
- FiO2 – Fractionated Inspired Oxygen
Ventilator Modes

- Spontaneous (Spont or CPAP/PS)
- Controlled Mandatory Ventilation (CMV)
- Assist/Control (A/C)
- Synchronized Intermittent Mandatory Ventilation (SIMV)
- Adaptive Pressure Ventilation (APV)
  - APV-CMV
  - APV-SIMV
- Pressure Controlled Ventilation (PCV)
  - PC-CMV
  - PC-SIMV
- Adaptive Support Ventilation (ASV)
- Airway Pressure Release Ventilation (APRV)
- High Frequency Oscillatory Ventilation (HFOV)
<table>
<thead>
<tr>
<th></th>
<th>f</th>
<th>VT</th>
<th>TARGET VT</th>
<th>PC</th>
<th>PEEP</th>
<th>PS</th>
<th>FiO2</th>
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<tr>
<td>SPONT</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<td>A/C or CMV</td>
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<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIMV</td>
<td>X</td>
<td>X</td>
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<td>APV-SIMV</td>
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<td>PC-SIMV</td>
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Weaning toward Liberation

- Traditional
  - Mode
  - FiO2
  - Peep
  - Frequency

- Provider Order Work Sessions
  - Spontaneous/CPAP/PS trials
  - Trach Collar/T-piece trials
  - Other Physician specific orders

- Spontaneous Breathing Trials
  - Peep = 5
  - PS = 5
  - FiO2 50% or less
Spontaneous Breathing Trials (SBT)

Every day, every ventilator patient is assessed for SBT participation.

- **Inclusion vs Exclusion**
  - Exclusion: continue with traditional weaning of parameters
  - Inclusion: perform SBT
# SBT Exclusion Criteria

<table>
<thead>
<tr>
<th>Spont Breathing Trial/Vent Work Session</th>
<th>Spont Breathing Trial Exclusion Criteria</th>
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</thead>
<tbody>
<tr>
<td>Type of Ventilator Session</td>
<td>Spont Breathing T...</td>
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<tr>
<td>Spont Breathing Trial Criteria Met</td>
<td>No</td>
</tr>
<tr>
<td>Spont Breathing Trial Exclusion Criteria</td>
<td></td>
</tr>
<tr>
<td>□ Provider order not to perform/list reason in &quot;Other&quot;</td>
<td></td>
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<tr>
<td>□ Ventilator dependent at home</td>
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<td>□ Brain death, elevated ICP, or suspected high ICP</td>
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<td>□ Withdrawal of life support to be within 24 hrs</td>
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<td>□ Active seizures</td>
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<tr>
<td>□ Therapeutic coma</td>
<td></td>
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<td>□ Therapeutic hypothermia (Code Cool)</td>
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<td>□ Neuromuscular blockade</td>
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<tr>
<td>□ Post-operative ECLS or VAD</td>
<td></td>
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<tr>
<td>□ Oxygenation worsening and on FiO2 &gt; 50% with SpO2 &lt; 92%</td>
<td>105/39 95/42</td>
</tr>
<tr>
<td>□ Refractory hypoxemia (P/F ratio &lt; 100 despite PEEP &gt; 10)</td>
<td>90 90</td>
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<tr>
<td>□ RR &gt; or = 35</td>
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<tr>
<td>□ Advanced ventilator modes (Eg. APRV, HFOV)</td>
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<tr>
<td>□ Mean arterial pressure &lt; 60 torr despite vasopressors</td>
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<td>□ HR &lt; or = 50 bpm or HR &gt; or = 120 bpm</td>
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<tr>
<td>□ Lung transplant</td>
<td></td>
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<tr>
<td>□ Post-operative open chest</td>
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<tr>
<td>□ Post-operative bleeding &gt; 150 ml/Hr&gt; = 4 hours</td>
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<tr>
<td>□ CI &lt; or = to 2.0 and SvO2 &lt; or = 60%</td>
<td></td>
</tr>
<tr>
<td>□ Non-sustained VT in past 24 hours</td>
<td></td>
</tr>
<tr>
<td>□ Sustained VT in past 24 hours</td>
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<tr>
<td>□ Cardiac arrest in past 24 hours</td>
<td></td>
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<tr>
<td>□ Bradycardia requiring pacing in past 24 hours</td>
<td></td>
</tr>
<tr>
<td>□ Patient failed SAT</td>
<td></td>
</tr>
<tr>
<td>□ Other</td>
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</table>

| Sedation Level                          | Heart Rate Monitored | Heart Rate | Blood Pressure NBP | Blood Pressure Aline | Blood Pressure Aline MAP | O2 Saturation | O2 Delivery Device | FiO2 (O2 %) | Continuous Positive Airway Press (CPAP) | Pressure Support (PS) | Unsupported Spontaneous Resp Rate | Unsupported Spontaneous Tidal Volume | Rapid Shallow Breathing Index | Spont Breathing Trial VS Obtained | Spont Breathing Trial Outcome | Spont Breathing Trial Unsuccessful | Provider Ordered Work Session Start Time | Work Session Trial Outcome |
|-----------------------------------------|----------------------|------------|--------------------|----------------------|--------------------------|---------------|-------------------|-------------|--------------------------------------|---------------------------|-----------------------------|--------------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|-------------------------------|------------------------------|-----------------------------|
| -1 Drowsy                               | 70                   | 92         | 105/39             | 95/42                | 98                       | 98            | 90                | 90          | 105/39                               | 95/42                     | 98                          | 98                            | 90                          | 90                          | 90                            | 90                          | 90                            | 90                          |
**SBT steps**

- **Initial Assessment**
  - Inclusion vs Exclusion determined by RT & RN
  - Begins approx 0200-0400, sedation to be lightened

- **Trial of Spontaneous breathing**
  - Coordinated by RT & RN with the SAT
  - Pre-SBT vital signs assessment completed
  - SBT begins: Peep=5 PS=5 FiO2= < or = 50%
  - 2 min vital signs assessment completed

- **Outcome**
  - Patient fails at 2min mark: requires increased ventilator support, continue with traditional weaning
  - Patient passes at 2min mark: continue SBT for >30 mins <2hours, contact MD for extubation or liberation orders
<table>
<thead>
<tr>
<th><strong>Spont Breathing Trial/Vent Work S...</strong></th>
<th></th>
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<tbody>
<tr>
<td><strong>Type of Ventilator Session</strong></td>
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<tr>
<td><strong>Spont Breathing Trial Criteria Met</strong></td>
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<tr>
<td><strong>Sedation Level</strong></td>
<td>-1 Drowsy</td>
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<tr>
<td><strong>Heart Rate Monitored</strong></td>
<td>109 bpm  ↑ 104 bpm  ↑ 104 bpm  ↑ 105 bpm  ↑ 105 bpm  ↑ 105 bpm  ↑ 105 bpm  ↑ 104 bpm  ↑ 107 bpm</td>
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<tr>
<td><strong>Heart Rate</strong></td>
<td>bpm</td>
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<tr>
<td><strong>Blood Pressure NBP</strong></td>
<td>112/78 mmHg  ↑ 118/78 mmHg  ↑ 110/63 mmHg  ↑ 105/63 mmHg  ↑ 111/73 mmHg  ↑ 133 mmHg</td>
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<td><strong>Blood Pressure NBP MAP</strong></td>
<td>mmHg</td>
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<tr>
<td><strong>Blood Pressure Aline</strong></td>
<td>89 mmHg  ↑ 91 mmHg  ↑ 77 mmHg  ↑ 77 mmHg  ↑ 86 mmHg  ↑ 9 mmHg</td>
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<tr>
<td><strong>Blood Pressure Aline MAP</strong></td>
<td>mmHg</td>
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<tr>
<td><strong>O2 Saturation</strong></td>
<td>% 100  ↑ 100  ↑ 100  ↑ 100  ↑ 100  ↑ 100  ↑ 100  ↑ 100  ↑ 100</td>
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<td><strong>Artificial Airway Type</strong></td>
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<td><strong>O2 Delivery Device</strong></td>
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<tr>
<td><strong>FiO2 (O2 %)</strong></td>
<td>% 30  30  30  30  30  30  30  30  30  30</td>
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<tr>
<td><strong>Continuous Positive Airway Press (CPAP)</strong></td>
<td>cmH2O  8  5</td>
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<tr>
<td><strong>Pressure Support (PS)</strong></td>
<td>cmH2O  15  5  12  12</td>
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<tr>
<td><strong>Unsupported Spontaneous Resp Rate</strong></td>
<td>br/min  23  35</td>
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<tr>
<td><strong>Unsupported Spontaneous Tidal Volume</strong></td>
<td>mL  527  329</td>
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<tr>
<td><strong>Rapid Shallow Breathing Index</strong></td>
<td>br/min/L  43.6  106.4</td>
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<td><strong>Spont Breathing Trial VS Obtained</strong></td>
<td>Completi... 2 minutes  ... Prior to SBT</td>
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<td><strong>Spont Breathing Trial Outcome</strong></td>
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<tr>
<td><strong>Spont Breathing Trial Unsuccessful</strong></td>
<td>RSBI &gt; 105  ...</td>
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<td><strong>Spont Breathing Trial End Time</strong></td>
<td>08/29/2014...</td>
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<tr>
<td><strong>Spont Breathing Trial Total Time</strong></td>
<td>Min  4</td>
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<tr>
<td><strong>Spont Breathing Trial Comment</strong></td>
<td>Pt remain...</td>
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</table>
## SBT transition to Work Session

| Time   | Type of Ventilator Session | Spont Breathing Trial Criteria Met | Sedation Level | Heart Rate Monitored | Heart Rate | Blood Pressure NBP | Blood Pressure NBP MAP | Blood Pressure Aline | Blood Pressure Aline MAP | O2 Saturation | Artificial Airway Type | O2 Delivery Device | FiO2 (O2 %) | Continuous Positive Airway Press (CPAP) | Pressure Support (PS) | Unsupported Spontaneous Resp Rate | Unsupported Spontaneous Tidal Volume | Rapid Shallow Breathing | Spont Breathing Trial Start Time | Spont Breathing Trial VS Obtained | Spont Breathing Trial Outcome | Spont Breathing Trial Unsuccessful | Spont Breathing Trial End Time | Spont Breathing Trial Total Time | Provider Ordered Work Session Start Time | Work Session Trial Outcome |
|--------|---------------------------|-----------------------------------|----------------|---------------------|-------------|-------------------|-----------------------|------------------------|--------------------------|-----------------|------------------------|------------------------|------------|----------------------------------------|--------------------------|-----------------------------|--------------------------------|----------------------|-------------------------------|--------------------------------|-------------------------------|-----------------------------|---------------------------|
| 11:37  | Provider ordered ...      | Yes                               | -1 Drowsy      | bpm 81              | 83 [2]      | mmHg 120/31      | mmHg 61               | mmHg 99                | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 24                          | mL 380                          | 63.2                 | 08/28/2014 08:54             | Completion of SBT            | Continued SBT / Ventilator... | Physician requested, add...  | 08/28/2014 11:35             | 161                         | 08/28/2014 11:37             | Work Session Trial Outcome  |
| 11:35  | Spont Breathing Trial     | Yes                               | -1 Drowsy      | bpm 83 [2]          | 94           | mmHg 120/31      | mmHg 61               | mmHg 97 [2]            | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 26                          | mL 380                          | 86.7                 | 08/28/2014 08:54             | 2 minutes on SBT            | Prior to SBT                 |                               |                           |                             |                           |
| 11:30  | -1 Restl... -1 Drowsy    | [2]                               | +1 Drowsy      | bpm 77              | 66           | mmHg 132/46      | mmHg 75               | mmHg 83                | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 26                          | mL 380                          | 86.7                 | 08/28/2014 08:54             | Prior to SBT                 |                               |                               |                           |                             |
| 10:20  | -1 Drowsy                | [2]                               | 0 Alert and calm| bpm 77              | 66           | mmHg 158/45      | mmHg 83               | mmHg 76                | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 26                          | mL 380                          | 86.7                 | 08/28/2014 08:54             | Prior to SBT                 |                               |                               |                           |                             |
| 09:30  | -1 Drowsy                | [2]                               | 0 Alert and calm| bpm 77              | 66           | mmHg 136/46      | mmHg 76               | mmHg 74                | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 26                          | mL 380                          | 86.7                 | 08/28/2014 08:54             | Prior to SBT                 |                               |                               |                           |                             |
| 09:00  | -1 Drowsy                | [2]                               | 0 Alert and calm| bpm 77              | 66           | mmHg 131/45      | mmHg 74               | mmHg 74                | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 26                          | mL 380                          | 86.7                 | 08/28/2014 08:54             | Prior to SBT                 |                               |                               |                           |                             |
| 08:56  | -1 Drowsy                | [2]                               | 0 Alert and calm| bpm 77              | 66           | mmHg 131/45      | mmHg 74               | mmHg 74                | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 26                          | mL 380                          | 86.7                 | 08/28/2014 08:54             | Prior to SBT                 |                               |                               |                           |                             |
| 08:54  | -1 Drowsy                | [2]                               | 0 Alert and calm| bpm 77              | 66           | mmHg 131/45      | mmHg 74               | mmHg 74                | Tracheostomy             | 40 %            | cmH2O 5                 | cmH2O 5                | 100        | 5                                      | 5                        | 26                          | mL 380                          | 86.7                 | 08/28/2014 08:54             | Prior to SBT                 |                               |                               |                           |                             |

**FLORIDA HOSPITAL**

Rehabilitation

The skill to heal. The spirit to care.
Goal of Mechanical Ventilation

- Resolve issue requiring mechanical ventilation
- Extubate intubated patient
- Liberate trached patient
Keys to Successful Outcomes

- Communication of Care Plans
  - Sedation, Delirium and Sleep
  - Early Mobility and Physical Therapy
  - Early Occupational Therapy
  - Communication and Swallowing

- Coordination of Care
  - Interdisciplinary Approach
    - MD, RN, RT, PT, OT, SLP, etc.

- Continuity of Care
  - Improved patient care and assessments
  - Trust bond formed with patient
Respiratory Therapy Roles

- Assess patients respiratory status, provide patients with adequate and appropriate oxygen therapy and respiratory support devices
- Coordinate care plan of patient with interdisciplinary team members
- Stabilize and liberate mechanically ventilated patients
- Coordinate SAT & SBT with RN
- Assist with mobility and therapy of mechanically ventilated patients in coordination with PT & OT
- Assist with communication and swallowing of trached patients in coordination with SLP