

Project Submission:
2009 Delaware Valley Patient Safety Award

MAGEE REHABILITATION HOSPITAL

*“Reduction in Ventilator-Associated
Pneumonia in an SCI Population”*

Abstract

While all facilities aspire to limit the incidence of ventilator-associated pneumonia, doing so within the confines of a spinal cord injury (SCI) population presents unique challenges. At our organization we have overcome these hurdles by utilizing a multi-disciplinary approach.

In April of 2008, we had several patients transferred from our facility to acute care with pneumonia. Several of these were patients on ventilators. We convened an interdisciplinary task force, performed chart reviews, and looked for commonalities among the patients. We noted that most patients diagnosed with aspiration pneumonia were tube fed and had histories of constipation and/or delayed gastric emptying, due to diabetes. Some of these patients noted that they could taste their tube feeding, which should not happen. We hypothesized that patients were aspirating their tube feeds because, due to the constipation or delayed gastric emptying, there was nowhere for it to go.

The task force developed guidelines for transitioning new patients from the 24-hour tube feedings that they receive in acute care to the 14-hour cycle feedings that they get in rehab. The guidelines included the use of a very low rate and volume, which is increased as the patient demonstrates the ability to tolerate it. Aggressive bowel management is initiated to insure that any constipation or impaction is addressed.

In the first seven months of 2008, we had five ventilator-associated pneumonias, among seven patients on ventilators. In the twelve months since that time, we have treated 14 patients on ventilators and have had no ventilator-associated pneumonias.

Title: Reduction in Ventilator-Associated Pneumonia in an SCI Population

Goals: Eliminate ventilator-associated pneumonia in an SCI population
Reduce aspiration pneumonia in our tube-fed patients

Baseline Data: In the first seven months of 2008, we treated seven patients on ventilators and had five incidences of ventilator-associated pneumonia. All of these patients had spinal cord injuries.

Interventions:

While all ventilator management programs aspire to limit the incidence of ventilator associated pneumonia, doing so within the confines of a spinal cord injury (SCI) population presents unique and imposing challenges. Overcoming these hurdles requires a multi-disciplinary approach. While the clinical application of certain techniques each contribute to our ability to reduce the incidence of a ventilator-associated pneumonia, their true power lies in their complimentary and organized execution.

The standard prescription formula for ventilatory support settings are inadequate to allow patients with SCI to thrive. Specifically, we deliver tidal volumes at abnormally high levels to help reduce the incidence of the most common respiratory complications of a spinal cord injury. These complications include atelectasis and pneumonia. This clinical technique is consistent with “best practice” among practitioners who treat this patient population (See Appendix A: Ventilator Weaning Guidelines and Appendix B: Respiratory Order Set.)

Our delivery of ventilator support utilizes a “dry” circuit. We use a heat and moisture exchanger (HME), as an integral piece of disposable equipment. The HME is placed within a standard ventilator circuit. The avoidance of a liquid based, artificially heated circuit decreases the potential for bacterial growth, within the closed system of a ventilator circuit.

Promotion of patient mobility is one of the cornerstones of therapy within the SCI population. Toward that end, the presence of ventilator support does not impede the attempt to make every patient as mobile as possible. Our ventilator-supported patients are out of bed with the same frequency and duration as our non-ventilator population. This dynamic is a proven factor contributing to positive outcomes including: enhanced pulmonary hygiene, elevated pulmonary function, and faster progression with ventilator weaning protocols. These in turn all decrease the potential risk of acquiring pneumonia in the ventilator-supported patient.

However, despite all of these efforts, in April of 2008, we noted that a number of patients who were transferred to acute care from our facility were found to have pneumonia. Several of these were patients on ventilators. These data were alarming to us, so we convened an interdisciplinary task force on 4/17/08. The group met three times from April to early June.

We performed chart reviews, and looked for commonalities among the patients. We noted that most patients diagnosed with aspiration pneumonia were tube fed and had histories of constipation and/or delayed gastric emptying, due to diabetes. Some of these patients had

complained about being able to taste their tube feeding, so we hypothesized that patients might be aspirating on their tube feeds because there was nowhere for it to go, due to the constipation or delayed gastric emptying.

In response to these findings, the group developed a set of guidelines for transitioning new patients from the 24-hour tube feedings that they get in acute care to the 14-hour cycle feedings that they get in rehab. The guidelines included the use of a very low rate and volume, which are increased as the patient demonstrates the ability to tolerate it. Aggressive bowel management is initiated at admission, to insure that any constipation or impaction is addressed.

Since the start of this project, we have done extensive staff education about the prevention of aspiration pneumonia, and we have developed a protocol for oral care, since this has proven to reduce the risk of pneumonia secondary to aspiration. (See Appendix C: Oral Care Protocol) We also developed guidelines for tube feeding. (See Appendix D: Tube Feeding Guidelines.) Physician order sets were created which include orders for aggressive bowel management at admission. (See Appendix E: Tube Feed Order Set.)

We are not certain whether it was the aggressive management of the bowels, the controlled changes to the tube feeding cycles, and/or the oral care, in addition to our SCI ventilator protocol, that helped decrease the aspiration risk and consequently, the ventilator-associated pneumonias. Our data are limited, but we are continuing to pursue the answer to this question.

Though our patients on ventilators have spinal cord injuries and neurogenic bowels, many other ventilated and non-ventilated patients are tube-fed and have the potential to aspirate tube feedings as well as their own secretions. Proper management of tube feedings, bowel routines, and oral care may all contribute to improved respiratory health. A formal study of these relationships would be a worthwhile undertaking.

Results: For the twelve-month period from 8/1/08 – 7/31/09, we treated fourteen patients on ventilators and had no incidences of ventilator-associated pneumonia. Again, all of these patients had spinal cord injuries.

How this initiative may be replicated:

This initiative may be replicated in other facilities via the use of the protocols and guidelines attached. The patients most at risk are those on ventilators, but any patient with an open airway and reduced swallowing capabilities has an increased level of risk of aspiration. Particularly at risk are those who are tube fed and are on ventilators.

Appendix A
RESPIRATORY CARE SERVICES POLICY AND PROCEDURE
SUBJECT: GUIDELINES FOR VENTILATOR-DEPENDENT PATIENTS

RESPIRATORY CARE SERVICES POLICY & PROCEDURE

SUBJECT:

Guidelines for Ventilator-Dependent Patients

PURPOSE:

To provide an individualized, practical and systematic method for discontinuing patients from mechanical ventilation as quickly, safely, and effectively as their condition permits.

SCOPE:

Respiratory care practitioners (RCPs) and all other clinicians with demonstrated competencies.

POLICY:

This Service will be delivered by members of the respiratory therapy department in accordance with the criteria developed and approved by their medical director and the hospital's medical executive committee.

PROCEDURE:

- I. Assessment
 - a. The Following Data will be considered when initiating respiratory care, therapy or when considering wean from mechanical ventilation

- Past medical history
- Current therapy regimen
- Accessory muscle use
- Mental status
- Results of previous weaning trials; Tidal volume (spontaneous)
- Negative Inspiratory Force
- Minute volume (spontaneous)
- Respiratory rate
- Respiratory rate/Tidal Volume (f/Vt)
- Recent arterial blood gas
- Oxygen saturation
- Resting heart rate
- Blood Pressure
- Recent chest X-ray
- Recent H & H
- Recent Na, K, Cl, Creatinine, & BUN
- Trach brand, size, and style

Appendix A

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- II. Once the order for ventilator weaning is written and verified by the respiratory therapist, the following guidelines can be utilized on a daily basis in evaluating the patient's ability to participate in weaning process, should the physician request. Failure to achieve one or more of these parameters may exclude the patient from the weaning process for that day.
 - a. Negative Inspiratory Force \geq 20 cm H₂O pressure
 - b. Spontaneous Resting Respiratory Rate < 35 bpm
 - c. Tidal Volume > 200 ml or > 3 ml/kg
 - d. Minute Volume \leq 13 lpm
 - e. F/ Vt (Frequency/Tidal Volume) ratio <105
 - f. Vital Capacity > 5 ml/kg
- III. Types of Wean
 - a. Based on the assessment, the weaning plan for the day will be formulated. The respiratory therapist will monitor the patient closely during these trials and will remain in the patient's room if necessary for the initial trial(s) to provide psychological and emotional support as well as immediate assistance should the patient fail the trial. The weaning plan options are:
 - i. Spontaneous breathing trial – Trach Collar
 - ii. Reducing ventilator support.
 1. The patient will be either:
 - a. Placed on a tracheostomy collar with an FiO₂ 0.10 higher than the ventilator setting, or
 - b. Placed on ventilator settings which permit the patient to do most of the work:
 - i. CPAP \leq 10 cmH₂O
 - ii. PS \leq 20 cmH₂O

WEAN TYPE: SPONTANEOUS BREATHING TRIAL: TRACH COLLAR TRIALS

Initial trial: The goal is to wean for at least 15 to 30 minutes but not to exceed 2 hours. However, shorter times may be necessary depending on the patient's ability to tolerate. Trials can be BID or TID dependent upon patient tolerance. After 4-5 hr weans BID, weans should be increased to 8-10 hrs daily. Increase by 1 hr/day up to 16hrs/daily. Spontaneous breathing trials can be increased 1-2 hrs per day. Consider continuous oxygen saturation monitoring.

- A. Changes in the patient's condition that indicate a return to ventilator support as necessary include:
 - a. Increased respiratory rate, work of breathing or dyspnea usually accompanied by diaphoresis
 - b. Heart rate increased or decreased by 20 bpm
 - c. 20% change in blood pressure from baseline
 - d. Inability to maintain satisfactory oxygen saturation
 - e. Evidence of aspiration
 - f. Seizure activity
 - g. Labored Breathing

Appendix A

RESPIRATORY CARE SERVICES POLICY AND PROCEDURE

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- B. When the trial is ended, the patient will be placed back on resting ventilator settings.
- C. Trials will be gradually increased as tolerated by the patient until they have successfully completed two (2) consecutive sixteen-hour trials.
- D. For patients on longer duration spontaneous breathing trials, they will be assessed with accompanying documentation at least every two (2) hours and more frequently if their condition warrants
- E. After the two (2) sixteen-hour trials, the patient will be given a 24 hour trail.
 - a. The patient will continue off the ventilator unless they exhibit changes that indicate resumption of ventilator support is necessary.
 - b. The ventilator will remain on standby in the patient's room for 72 hours. After 72 hours, the ventilator will be removed from the room and the patient will be considered weaned.

WEAN TYPE: VENTILATOR SUPPORT WEAN

- A. Certain patients may require higher levels of ventilator support, which do not permit spontaneous breathing trials. These patients will require weaning of their ventilator support to a level at which spontaneous breathing trials may be initiated. This may include a necessity to reduce SIMV and/or Pressure Support levels. This will be done as delineated below.
- B. SIMV Weaning Protocol
 - a. Weaning is performed from 6 AM to 10 PM
 - b. Reduce SIMV rate by 1-2 breaths per minute every 1 to 2 days.
 - c. Assess the patient after each rate reduction. If SaO₂ and other vital signs remain at acceptable levels, no arterial blood gas is needed. Along with O₂ saturation, the patient's respiratory rate, heart rate, blood pressure, skin pallor, and mental status will be assessed.
 - d. If patient reaches a level where further SIMV weaning for that day is not possible:
 - i. Increase the rate by 2 breaths per minute and allow the patient to rest on new rate for remainder of day and evening.
 - ii. Notify the patient's nurse of resting rate.
 - iii. Document assessment findings and resting ventilator settings.
 - iv. Continue to SIMV wean beginning next day, as tolerated.
- C. When SIMV is weaned to 4 breaths per minute, move to CPAP mode and begin Pressure Support weaning
- D. Weaning from Pressure Support
 - a. Place ventilator into CPAP mode and PEEP < 5cmH₂O (if possible)
 - b. Maintain Pressure Support level from SIMV settings. If pressure support was not used with the SIMV, begin Pressure Support at 15.
 - c. Decrease pressure support by 2 cm H₂O pressure every 1 to 2 hours as long as respiratory rate remains less than 30 per minute and tidal volume remains 300 - 350 ml.
 - d. Assess patient following parameters listed in SIMV after each ventilator setting change.
 - e. At 10 PM return ventilator settings to a pressure support level adequate to

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- f. keep the patient comfortable, respiratory rate < 25 and tidal volume > 350 ml.
- g. At 6 AM return ventilator settings to CPAP mode and resume pressure support reduction.
- h. If at any time the patient does not tolerate reduction in pressure support, return to last tolerated pressure support setting. If patient still does not tolerate, increase pressure support to achieve respiratory rate < 25 and tidal volume > 350ml. If unable to achieve a respiratory rate < 25 and tidal volume \geq 350ml, return to "full" ventilator support. Notify patient's physician and nurse of ventilator setting changes and reasons for changes. Document changes and reasons for changes in patient chart.
- i. When a pressure support of 5 cm H₂O pressure is reached and tolerated, begin spontaneous breathing trials.
- j. If a patient's daily weaning parameters indicate they are a candidate for spontaneous breathing trials, they may be moved to the spontaneous breathing trial portion of the protocol at that time.

WEAN TYPE: SCI VOLUME INCREASE WEAN

- A. This wean is strictly for SCI patients with normal healthy lungs.
 - a. Increase VT by 50cc every three days to reach goal of 15-20ml/kg.
 - b. Keep PIP \leq 30
 - c. Watch BP and HR closely
 - d. Once goal is reached, start trach collar trials when appropriate. (See: trach collar trial wean)

NOTE: The reason for this type of ventilator change is to combat persistent atelectasis, and recurrent pneumonias to which SCI patients are prone.

- B. FIO₂ levels
 - a. FIO₂ should remain the same or be slightly higher than pre-weaning levels during the weaning process. They may be adjusted as necessary to maintain a SpO₂ > 92%
 - b. FIO₂ can be titrated down following successful weaning from the ventilator.
 - c. If complete weaning from the ventilator is not achieved, then FIO₂ titration should begin when the mechanical ventilation plateau level has been reached.
 - d. FIO₂ may be weaned first in some instances.

IV. If at anytime during the ventilator weaning process there is a problem or the respiratory practitioner has a question, the physician should be called immediately to determine a further course of action.

V. The physician has ultimate authority and may override or amend these guidelines for a particular patient.

Appendix A

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Reference: Ventilator Weaning Protocol, Craig Hospital

Originating Source: Consortium for Spinal Cord Medicine

Effective Date: 1/09/09

Reviewed Dates: 1/09/09

Revised Dates: 1/09/09

| Appendix B: RESPIRATORY ORDER SET (Deselect any choices which do not apply.)

 Medical Order Vent Orders as per protocol

Medical Order Vent weaning orders as per protocol ___

Medical Order Suction prn

Medical Order Assisted cough prn

Medical Order CPT/PD prn

Medical Order Trach-passy - Muir valve; comments: ___

Medical Order Coughalate PRN

Medical Order Coughalate contraindicated by MD

Medical Order Vital capacity daily

Medical Order Vital capacity prn

Medical Order Trach care Q Shift & prn

Medical Order Trach change monthly & prn (done by MD or RT)

Medical Order Respiratory, reason for consult: ___ (CONSIDER FOR OPEN AIRWAY PATIENTS)

Medical Order Jefferson pulmonary, consult: ___

Medical Order ENT, consult: ___

Medical Order O2 Ther - identify flow rate & mode of delivery: ___

Medical Order Respiratory Misc, comments: ___

Medical Order Chest vest per RT

Medical Order Chest vest relative contraindicated eval by MD

Medical Order Pulse ox continuous

Medical Order Pulse ox continuous - re-evaluate in 48 hours (CONSIDER FOR OPEN AIRWAY PATIENTS)

Medical Order Call doc if behavior change threatens medical healing - PRN

Medical Order CPAP Orders - settings as per Respiratory

Medical Order BIPAP Orders - settings as per Respiratory

Appendix C: Oral Care Protocol

All patients are provided with oral care. Those who are able to self-care, will be provided with toothpaste and brush, mouthwash, as needed, by Nursing via supplies from Purchasing. This requires no action from the physician. Generally, patients perform their own care B.I.D. Patients needing assistance with oral care will receive this from Nursing, from item retrieval, to set up, to minimal assist on up to maximum assistance.

Some patients have additional risk factors which require **specific oral care procedures** that will reduce risk of infection, complications due to aspiration, and oral fungal/thrush infections that require aggressive oral care. For these patients, the NP or Physician will order: "Oral Care per Protocol." The **specific oral care procedures** include:

- Suction set up
- Oral care performed in upright position, seated or elevated head of bed.
- Q 4 hour oral hygiene using the Sage oral care kit. (Obtain from Purchasing)
- Q 12 hour chlorhexadine gluconate (CHG) oral rinse (requires a separate Pharmacy Order) in conjunction with oral care.
- Oral suctioning with mouth care and p.r.n for oral secretions
- Inspect oral cavity
- Assess patient for:
 - reports or demonstrates signs of aspiration,
 - pocketing,
 - oral discomfort
 - oral infection, e.g., Candida Albicans (thrush/yeast)
 - loose, broken or painful teeth
- Notify physician of any concerns with regard to oral care or condition of oral mucosa.

Populations who will receive Q 4 hour care:

- All open airways (vents, trachs)
- All patients with Candida Albicans (oral thrush)
- *Most* patients who are NPO excepting those who are able to provide adequate self-care of the oral mucosa and are not subject to ingesting fluids against their status.

6/9/09

Appendix D: Admission Tube Feeding Guidelines

Purpose:

To promote the safe administration of enteral tube feedings, starting at the time of the patient's admission.

Rationale:

Patients who are admitted from acute care who are on tube feedings require adjustment in their tube feeding regimens:

- In rehab, tube feedings run for 14 hrs, not for 24 hrs, as in acute care, to allow for therapy.
- The tube feed rate is lowered to reduce the risk of aspiration related to unknown bowel status.
- Our enteral formulary often requires a change in formula.
- Because these changes reduce the amount of carbohydrates that the patient receives from ~275g down to ~60g, any insulin schedule as per the transfer sheet needs to be discontinued. **The insulin dose must be reduced** as part of the admission orders!

Procedure:

- The nurse or physician pages the dietitian to assist with converting the tube feeding and/or insulin orders.
- Physician Orders:
 - Enter diet order.
 - Enter Tube Feeding Order Set
- If the dietitian cannot be reached, the physician orders the default tube feeding regimen:
 - Nutren Pulmonary @ 40 mLs/hr from 6pm to 8am
 - Two separate flush orders:
 - 35 mLs/hr during feeding 6pm-8am AND
 - 250 mLs qid
- If the patient is on insulin:
 - Reduce the previous dose by at least 50%, but order a minimum of 5 units of Lantus q 9pm for patients on long acting/basal insulin.
 - Do not order any long acting/basal insulin for the morning time, i.e. Lantus or NPH.
 - Do not order any NPH Mixed insulin. Convert to Lantus q 9pm or NPH with start of TF @ 6pm.
 - TF/NPO Sliding Scale & Accucheck Orders:
 - “Insulin - standard Lispro”
 - “Accuchecks q 6 hours, no coverage at midnight.”
 - “3 am accucheck with no coverage” for 3 days.
 - TF/PO Diet Sliding Scale & Accucheck Orders
 - “insulin – standard Lispro”
 - “Accuchecks ac and HS, no insulin @ HS”
 - “3 am accucheck with no coverage” for 3 days
- Nursing procedures
 - Keep HOB locked @ 30-45 degrees or keep patient upright in chair while TF is running.
 - Do not turn off TF for repositioning.
 - Hold TF only if residuals are \geq 500 mLs or for complaints of N/V (ASPEN Critical Care Guidelines, 2009).

Appendix E

TUBE FEED ORD SET

Medical Order Tube Feed Protocol

Pharmacy CHLORHEXIDINE ORAL RINSE 7.5ML 0.12%
Pharmacy BISACODYL (FLEET BISACODYL) ENEMA 10MG 1X

DIETARY =>RD TUBE FEED CONSULT<=
DIETARY =>TUBE FEED SUPLMT PER RD<=