

# Perspectives

Recovery Strategies From the OR to Home

**CEs for  
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Respiratory  
Therapists**

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## Learning Objectives

After reading these articles, the learner should be able to:

1. Compare the evidence supporting the bundle elements recommended for reducing VAP in the ICU patient
2. Describe the modalities referred to as early mobilization
3. Discuss early versus late complications
4. Describe methods to secure a tracheostomy tube
5. Discuss how morbid obesity increases the risk of accidental cannulation

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## Faculty Disclosures

Nurse Planner: Lisa Caffery, MS, RN, CIC disclosed no conflicts of interest.

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# Fighting VAP one step at a time: Early mobility for the ventilated patient

By Lois K. Andrews, MSN, RN-BC, CCRN, ACNS-BC

Great strides in reducing the incidence of ventilator-associated pneumonia (VAP) have occurred since prevention bundles were introduced with the "Save 100,000 Lives" campaign by the Institute for Healthcare Improvement (IHI). Critical care units everywhere have adopted and monitor compliance with the elements of the bundle. Through the use of these actions, dramatic reductions in VAP have been reported. Still, controversy exists over the scientific basis of bundle elements<sup>1-3</sup> and definitions of VAP.<sup>4</sup>

This article reviews the evidence supporting or questioning recommendations for VAP prevention published by the IHI and the Centers for Disease Control and Prevention (CDC). It will then explore the evidence-based practices being implemented beyond the basic bundle including early tracheostomy and early mobility (including the "ABCDE bundle"). The rationale, techniques employed to maintain patient safety, and an example of an early mobility program will be presented. Tips for implementing a program will be provided.

## VAP Prevention Bundles

The VAP prevention bundles were first introduced by the IHI in 2004. Key components include elevation of the head of the bed, daily "sedation vacations" paired with assessment of readiness to wean, peptic ulcer disease prophylaxis, and deep vein thrombosis prophylaxis. In 2008, O'Keefe and colleagues published the results of a 2-year

study in the United States and Canada on the clinical outcomes of adherence to the bundle elements.<sup>5</sup> This study demonstrated that not only could ventilator days and ICU length of stay (LOS) be reduced, but VAP rates could be reduced as well. In 2010, the IHI added daily oral care with chlorhexidine based formulations after a literature review on research done in Europe was published.<sup>6</sup>

The IHI is not the only agency to publish data on a ventilator bundle. The CDC<sup>7</sup> and American Association of Critical Care Nurses (AACN)<sup>8</sup> have also made recommendations for preventing VAP. They endorse elevation of the head of the bed (HOB) and oral care, (including using a moisturizer) but also include eliminating routine ventilator circuit changes, use of an endotracheal tube (ETT) with continuous aspiration of subglottic secretions (CASS) and stress handwashing prior to any manipulation of the airway or circuit. Neither of these agencies has endorsed the use of chlorhexidine gluconate (CHG) for routine mouth care except for cardiac surgery patients, but AACN has issued a practice alert on techniques for oral hygiene.<sup>9</sup>

Despite the apparent success of ventilator bundles in decreasing the incidence of VAP, controversy exists. Realizing the link between VAP and increased mortality, some authors question why the mortality rate from VAP has not significantly decreased due to bundle implementation.<sup>1</sup> Others point to the lack of research supporting many of the ele-

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# Tracheostomy: Do we need to be concerned about the complications?

John Davies MA RRT FAARC

The procedure of tracheostomy was formally documented first in the early 1900's.<sup>1</sup> A tracheostomy tube is used to secure the airway and its use reduces the chances of laryngeal injury. It may also enhance weaning and allow for transfer to a step down unit or sub-acute care facility.<sup>2,3</sup> Since its inception, tracheostomy has become one of the more frequently performed procedures in ICU care. It has been estimated that 15-20% of ICU patients undergo tracheostomy at some point during their clinical course.<sup>4,5</sup>

Tracheostomy offers several important advantages over endotracheal intubation; 1) Lower airway resistance due to the shorter tube length, 2) Less dead space, 3) Less tube movement within the trachea, 4) Patient comfort, 5) More efficient suction, 6) Less risk of laryngeal and supraglottic injury, 7) Facilitation of easier patient mobilization and 8) Allowance of oral feeding and communication.<sup>5-7</sup>

Over the years many technological advances have occurred both in terms of the procedure and the tracheostomy tube technology. Unfortunately recent objective data describing complications are sparse and our generalized knowledge of complications is based on mostly dated literature. To that point, obesity has been on the rise in the last couple of decades and therefore very little association has been made between obesity and tracheostomy complications in this early literature. In this paper I will attempt to describe the types and incidences of complications in light of today's technology and population distributions.

## Complications of Tracheostomy

Complications from tracheostomy can be grouped into 3 time-referenced phases: intraoperative, early postoperative and late postoperative. Intraoperative complications

include hemorrhage, air embolism, apnea, damage to adjacent structures and intraoperative fire. The focus of this paper, however, will be on early and late postoperative complications. It has been estimated that the rate of early postoperative complications is somewhere between 3.2% - 18.2%.<sup>8-10</sup> Late postoperative complication rate is more difficult to estimate accurately due to the presence of comorbid conditions, failure to yield clinically detectable symptoms and the fact that it is difficult to separate complications related to endotracheal intubation versus tracheostomy. Indeed, estimates of late postoperative complications range widely from 7.1% to upwards of 65%.<sup>9,11-13</sup>

Late complications of tracheostomy generally stem from continuing irritation of the tracheal wall from the tube and the presence of an artificial airway for a considerable length of time. The complications include tracheal stenosis (granulation tissue), tracheomalacia, tracheoinnominate fistula (hemorrhage), tracheoesophageal fistula, pneumonia and aspiration.<sup>14,15</sup> Tracheal stenosis refers to an abnormal narrowing of the tracheal lumen which can occur at the level of the stoma, above the stoma (below the vocal cords), at the site of the tracheostomy tube cuff or at the distal tip of the tube. As granulation tissue develops initially it is soft and vascular. Some hemorrhage may occur during this phase. As the granulation tissue matures it becomes fibrous and becomes covered with a layer of epithelial tissue. This granulation tissue may make it difficult to replace the tracheostomy tube in the event of an accidental decannulation due to the narrowed airway. The granulation tissue can also occlude a fenestration leading to delays in successful planned decannulation. It has been estimated that tracheal stenosis may not produce symptoms

until the tracheal lumen has been reduced by 50 -75%.<sup>12</sup> Clinically, tracheal stenosis should be suspected in a patient exhibiting unexplained difficulty with weaning or decannulation. Tracheomalacia is a weakening in the tracheal wall due to ischemic injury to the trachea. Chondritis then ensues followed by necrosis of the supporting tracheal cartilage. This, in turn, results in airway collapse leading to expiratory airflow limitation, gas trapping and the development of autoPEEP. Secretions can also become retained and there is potential for compression of the trachea by surrounding structures further compounding the issue of airway narrowing. Patients with tracheomalacia usually present with a "failure to wean" scenario unexplained by other causes. The most feared complication for a clinician caring for a patient with a tracheostomy is tracheoinnominate artery erosion. Although a rare complication, the result of this complication is a rapid bleed out of the patient and the mortality from this approaches 100%.<sup>16</sup> The innominate artery lies adjacent to the trachea and crosses it around the 9th tracheal ring. Risk factors for tracheoinnominate artery erosion include long term tracheostomy, excessive movement of the tracheal tube or a tube that has been placed too low. Another relatively rare late postoperative complication is the tracheoesophageal fistula. This is a perforation of the posterior tracheal wall caused either by damage from the insertion of the tube, excessive cuff pressure or damage from the tip of the tracheostomy tube. Some of the symptoms include aspiration of tube feed, cuff leak and severe gastric distention. There is potential for pneumonia to develop in patients with a tracheostomy due to the fact that the upper airway defenses have been bypassed. The longer the tube remains in place increases the chances of ventilator-associated pneumonia or events. Finally, aspiration is a concern due to the fact that the tracheostomy tube itself disrupts the swallowing mechanism especially if the tracheostomy tube cuff is overinflated leading to the compression of the esophagus.

Early postoperative complications include hemorrhage, infection, tube dislodgement, subcutaneous emphyse-

ma, pneumothorax and pneumomediastinum. Hemorrhage is considered a rather frequent complication that, in most cases, involves minor oozing that can be treated effectively by pressure dressings. However, severe postoperative hemorrhage can occur. In a retrospective study of 1130 patients that underwent tracheostomy, 7 cases resulted in severe hemorrhage that required surgical intervention.<sup>14</sup> The authors of this study acknowledged that there were probably frequent cases of mild postoperative oozing but they did not follow them. Infections are also a concern in the early postoperative phase if the wound is not properly cleaned. Dressings need to be changed frequently because blood and secretions can rapidly accumulate resulting in bacterial colonization. Subcutaneous emphysema, pneumothorax and pneumomediastinum can result from dissection of the tissue planes and the use of excessive ventilatory pressures. The incidences of these complications occurring vary from 0-9%.<sup>17,18</sup> The use of excessive ventilatory pressures is much less likely now with the advent of lung protective ventilation.

Accidental decannulation can be a fatal complication that, while it can happen in the late postoperative phase, is most likely to occur in the early postoperative phase. It has been estimated that the rate of accidental decannulation is anywhere from 0% to 7%.<sup>3,9,19</sup> While the accidental decannulation rate appears to be fairly low, the loss of the airway may prove life-threatening. Signs that a tracheostomy tube may have become dislodged include the following: increased work of breathing, noisy breathing, signs of impending respiratory failure, voice changes (if the patient is able to phonate), subcutaneous emphysema, flange in an odd position, cuff visible in the stoma, monitoring changes (drop in the pulse oximeter or loss of end-tidal CO<sub>2</sub> measurements and hemodynamic changes), lack of breath sounds on auscultation and inability to pass a suction catheter. Factors that may increase the risk of accidental decannulation are morbid obesity, short or thick neck, goiter, prior radiation or surgery of the neck, devices or lines located near the ventilator circuit, patient movement, inadequately



Figure 1A. Tracheostomy Tube Holder (Dale Medical Products)



Figure 1B

secured tubes and frequent coughing.

Adequate securement of the tracheostomy tube is vital especially in patients at risk of accidental decannulation and in the early postoperative phase. It has been suggested that the use of sutures attaching the tracheostomy tube to the peristomal skin is appropriate in the early postoperative phase.<sup>14,20</sup> String ties can also be used but the tightness of fit should be re-evaluated on a regular basis. The ties should fit snugly around the neck so as to minimize tube movement but not too tight to avoid neck constriction and ulceration. The clinician should be able to pass a finger between the ties and the neck. Other methods of securement include twill tape, specially manufactured hook and loop (Velcro<sup>®</sup>) ties, and metal bead chains.

Twill tape is probably the most common method to secure a tracheostomy tube. It comes packaged in a roll and is the cheapest method. Cost should be balanced in terms of nursing convenience and potential for skin irritation. The clinician should cut 2 lengths of twill tape that, combined should be larger than the circumference of the neck. A slit should then be cut near the end of piece of tape. The tape is threaded through the tracheostomy tube flanges and slits from the skin side out before being tied at the side of the neck. As with the strings mentioned above, the tape should be loose enough to allow passage of a finger between the tape and the neck.

Commercially available tracheostomy tube holders with hook and loop fasteners usually consist of a soft neck band connected at the ends by fastener tabs to attach the 2-piece neckband. The neck band is placed around the

neck. The fastener tabs are threaded through the tracheostomy tube flanges (again from skin side out) and attached to the neckband. These devices are more comfortable for the patients due to the wider foam interface but, at the same time, are more expensive. Cost must be balanced with reduced nursing time and less potential skin irritation and complication particularly in the obese patient. (Figure 1A and 1B)

Stainless steel beaded chains exist mainly in the pediatric population. Some clinicians prefer this method in the pediatric patient because it is very durable and will not trap moisture. At this time there is no specific data that indicates the superiority of one type of tie over another.

With the morbidly obese patient twill tape, because it is narrower, has the potential to cut into the excess tissue folds around the neck. This, in turn, can make patients uncomfortable and increase the chances of them decannulating themselves. Bariatric sized ties that are wider than standard may reduce this risk due to the fact that they are more comfortable. (Figure 1B)

Another important aspect in the prevention of accidental decannulation is the presence of a multi-disciplinary team and educational programs targeted at proper tracheostomy care.<sup>3,21</sup> The multi-disciplinary team allows for more sets of eyes on the patients as well as care that encompasses the many facets of patient care. Educational programs enable clinicians to deliver proper tracheostomy care as well as identifying risk conditions that may lead to accidental decannulation.

Malposition of the tracheostomy

tube is also a potential complication of tracheostomy. In a recent retrospective study the authors found that tracheostomy tube malposition occurred in 10% of the tracheostomized patients.<sup>22</sup> The most common culprit was occlusion of the distal end of the tracheostomy tube by the posterior wall of the trachea. Malposition of the tracheostomy tube was associated with a longer duration of mechanical ventilation and the main risk factor was being short in height.

### Implications of Morbid Obesity on the Occurrence of Tracheostomy Complications

Up until recently studies relating to complications of tracheostomy have excluded the morbidly obese and thus the literature on these patients is scarce. However, the incidence of morbid obesity has steadily been on the rise in the last 3 decades. Patients who are morbidly obese can pose significant challenges to the clinical care team. In addition to the above mentioned tracheostomy complications morbidly obese patients carry a unique set of risk factors that should be highlighted.

Morbidly obese patients present a special challenge due to the excessive submental and anterior cervical adipose tissue. This excess tissue distorts the true angle of the trachea and adds additional distance between the phlange of the tracheostomy tube and the trachea. This then leads to an increased risk of accidental decannulation and tube obstruction. Figure 3 is

## Literature is emerging identifying obesity as a significant risk factor in tracheostomy complications.

an MRI scan of a patient with a normal sized neck. The contour of the trachea follows the same general contour of the skin. Figure 4 shows an MRI of an individual with a short thick neck representative of a morbidly obese patient. The contour of the skin in this case changes abruptly and swings away from the trachea as opposed to being in line with the trachea. This poses a couple of problems. First, the distance from the skin to the trachea is increased and a normal sized tracheostomy tube may not be long enough to provide for adequate ventilation and it increases the risk for accidental decannulation. Second, if an accidental decannulation does occur, reinsertion of a tracheostomy tube will probably prove challenging sine the contour of the trachea will have disappeared. Also, as most commercially available tracheostomy tube sizes are based on normal anatomic proportions, the tube will most likely be of inadequate length to suit the obese patient.

How often do complications from tracheostomies occur in the morbidly obese population? Literature is emerging identifying obesity as a significant risk factor in tracheostomy complications. Byhahn et al. studied 73 obese patients and 401 non-obese patients. They found that complications occurred in 43.8% of the obese group versus 18.2% in the non-obese group.<sup>8</sup> Another study carried out around the same time followed 500 consecutive patients with a tracheostomy and the authors found that the obese group (BMI >30) had a significantly higher risk of developing complications as compared to the non-obese group (20% vs. 7%,  $P < 0.05$ ).<sup>23</sup> In a single center study the authors wanted to look at the complication rates of normal sized patients versus morbidly obese patients after undergoing an elective tracheostomy. They were able to follow 427 patients and found that incidence of complications in the morbidly obese population was 25% as compared to 14% in the control group.<sup>24</sup> The obese group also had a much higher rate of severe complications consisting of tube obstruction and accidental decannulation. This group had a 30% mortality rate in the patients who experienced accidental decannulation. Another recent retrospective study looked at 30-day mortality rate of patients with a BMI >35 versus patients in the normal weight range who underwent a tracheostomy.<sup>25</sup> The result was a mortality rate of 29% in the morbidly obese group as compared to 18% in the normal

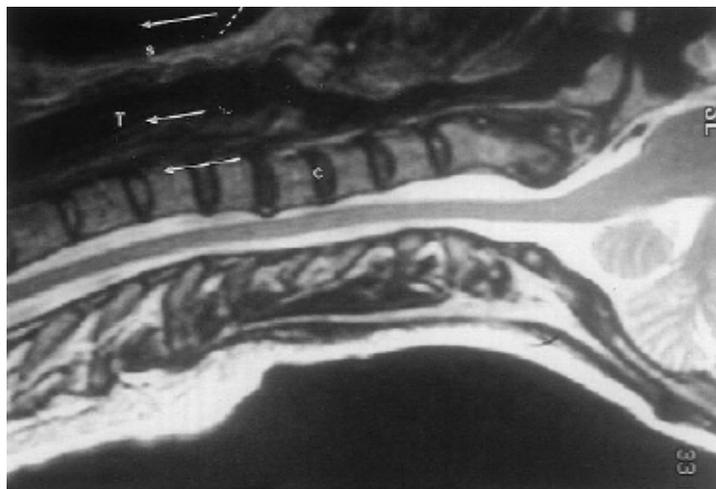


Figure 3. MRI of a patient with normal neck anatomy. T – trachea, S – Skin contour. C – cervical spine

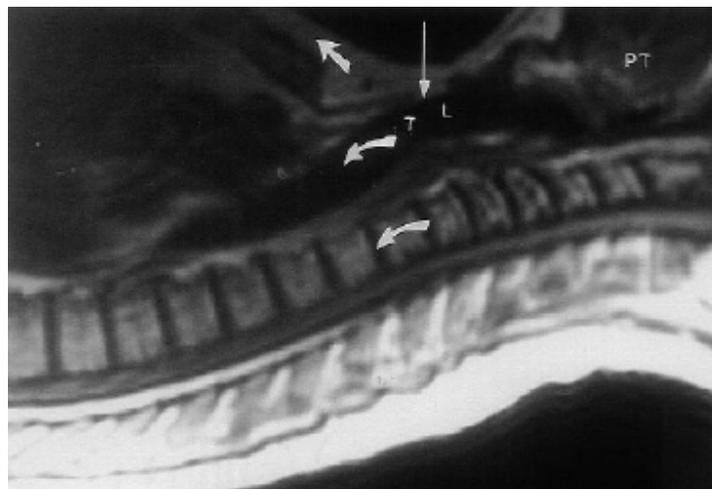


Figure 4. MRI of a patient with a short thick neck. T – Trachea, Curved arrows – Direction of the contours cervical and thoracic spine contours, Straight thick arrow – Direction of the skin contour, Thin straight line – Position of the cricoid ring, PT – Posterior tongue, L – larynx  
Figures 3 and 4 taken from ref 27 Muhammed

weight group. The authors also were able to correlate an escalating mortality rate with increasing BMI.

Clearly, it seems that morbidly obese patients are at a much greater risk of developing complications relating to tracheostomies and, in particular, fatal airway events (obstruction, accidental decannulation, inability to reestablish a patent airway). There are commercially available extended length tracheostomy tubes available for this patient population. However, they vary from manufacturer to manufacturer in terms of length, size, material and the presence (or lack of) cuffs and inner cannulas. The sizes and lengths of these specialized tracheostomy tubes are neither standardized nor based on specific scientific data. The other issue with this group of tubes is cost. It is not practical for institutions to carry all available types and sizes. They can be specially ordered but this takes time and time is not what morbidly obese patients have when an airway is lost. To compound the issue is the fact that even these specialized tracheostomy tubes may not be long enough for some of the more morbidly obese patients.<sup>26</sup> Morbidly obese patients with a tracheostomy definitely require more intense surveillance and monitoring, care from a multi-disciplinary team and specialized equipment to minimize the potential complications that they may be exposed to.

### Summary

Tracheostomy is one of the more common procedures in the ICU setting. Since the number of ICU patients is on the rise, the number of tracheostomies, in all likelihood, will also rise. It has advantages over endotracheal intubation in that it is generally a more stable airway offering less resistance to flow and lower work of breathing and more comfortable. The patients can do mouth care and, in some cases, speak while the tube is in place. Complications from tracheostomy in the “normal” sized population are not common but also are not isolated events. Clinicians must be aware of what these complications are and what to do when one occurs. Complications from tracheostomy become

magnified in the morbidly obese population due to excess neck tissue. Loss of an airway is much more of an issue with this population since it occurs more and it is more difficult to reestablish a patent airway. Clinicians must not take tracheostomies for granted and assume that these patients will wean without any problems. These patients require appropriate surveillance and monitoring to minimize the chances of any complications occurring.

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Fighting VAP one step at a time:  
Continued from page 1

ments.<sup>2</sup> So, which of the interventions to prevent VAP are supported by evidence? Since DVT and PUD prophylaxis require physician orders, they will not be reviewed. Instead, evidence on the elements to base nursing care will be presented.

### Head of Bed Elevation

Elevation of the head of bed (HOB) is one of the few individual elements supported by research.<sup>5</sup> This position allows better diaphragmatic excursion and reduces the risk of aspiration. Maintaining the HOB greater than 30 degrees sounds like a reasonable accomplishment, but observational studies contradict this. Mean HOB elevations between 19 degrees<sup>10</sup> and 28 degrees<sup>11</sup> have been reported. Factors influencing lower elevations include vasopressor medications and hypotension.<sup>12</sup> Routine turning and positioning, procedures, and testing require the patient to be in the supine position, adding to the time HOB elevation is not maintained. Studies are underway to examine complications theoretically associated with HOB elevation such as pressure ulcer development and venous congestion leading to thromboembolism formation.

### Daily Sedation Vacation and Assessment of Readiness to Wean

Key components in ventilator liberation are the daily “sedation vacation” and wean screen. Initial studies demonstrated a 33% (2.4 days) reduction in ventilator LOS and a 35% (3.5 days) reduction in ICU LOS.<sup>13</sup> To be effective, these require coordination between the nurse and the respiratory therapist.<sup>14,15</sup> If the patient is not awake and cooperative, they will fail a wean assessment and not be eligible for a spontaneous breathing trial and extubation. Protocols that allow the nurse to adjust the patient’s sedation level, rather than requiring specific physician orders, have been shown to decrease VLOS, ICU-LOS & hospital LOS.<sup>16</sup> The best protocols include a valid and reliable tool to measure sedation level while using a protocol. SCCM guidelines<sup>17</sup> now recommend patients to be maintained at the light-

## Considering the mechanisms of microaspiration, placing a suction port on the top of the ETT cuff to evacuate secretions that migrate down the outside of the tube seems a logical way to avoid VAP.

est level of sedation possible, which may not require daily interruption.

Additional benefits include limiting the accumulation of sedative drug, especially important with benzodiazepines, and allowing accurate assessment of the patient’s neurological status. Studies using daily sedation interruptions report no increase in ICU complications such as MIs, PTSD, or delirium.<sup>13,16,18</sup>

### Daily Oral Care

The presence of bacteria in the oral cavity has been identified as a source for VAP. As early as 2003, the

CDC guidelines included oral hygiene and oral decontamination.<sup>19</sup> Many studies have addressed products as well as techniques.<sup>20</sup> The ETT bypasses the body’s natural defenses in the upper airways and creates a pathway for microorganisms to migrate into the lungs. This process is known as microaspiration and can be increased with suctioning and other tube manipulation. Pre-existing sinusitis and poor oral hygiene are factors that increase the risk of VAP.<sup>21</sup> Reducing bacterial colonization is essential in preventing VAP. Chan et al<sup>6</sup> found a lower risk of VAP after implementing an oral decontamination process. Other studies<sup>22,23</sup> support the use of CHG over other antimicrobial agents for oral care.

Despite the importance of oral hygiene, several authors have found patients in the ICU are not receiving proper oral care.<sup>24</sup> Some of the barriers identified include fear of dislodging the ETT, fear of the patient aspirating during the procedure, perceived discomfort of the patient, time and personnel. The use of commercial tube holders can eliminate many of these barriers. Unlike traditional taping of the ETT, commercially available tube holders secure the tube, yet allow manipulation and repositioning of the ETT. Staff has better access to the oral cavity for more thorough oral care and suctioning, thus reducing microaspiration. The holders are more flexible and staff can easily reposition the tube to prevent pressure and patient discomfort. Including other members of the care team (RTs) to perform oral care is another alternative.<sup>25</sup>

### Use of Subglottic Suction/drainage ETT

Considering the mechanisms of microaspiration, placing a suction port on the top of the ETT cuff to evacuate secretions that migrate down the outside of the tube seems a logical way to avoid VAP. In fact, studies have demonstrated up to 50% reductions in VAP especially in the first 5-7 days after intubation.<sup>26,27,28</sup>

After the initial introduction of the tubes, increased cost and the larger outer diameter of the tube were identified as problems. In addition, patients who would be on mechanical ventilation for longer periods of time were difficult to identify prior to intubation.

Table 1

Respiratory Effects of Immobility
• Decreased respiratory motion
• Increased risk of pulmonary embolism
• Increased dependent edema
• Compression atelectasis
• Decreased movement of secretions
• Weakened muscles -> an increased oxygen demand
• Weakness presents challenges to weaning

(reference: Perme C, Chandrashekar R, 2009.)

Other difficulties reported were maintaining patency of the suction port and hissing from the suction.<sup>27</sup> Recent studies have raised questions on complications associated with these tubes, including tracheal mucosal drying and injury, leading to an increased incidence of laryngeal edema and the need for reintubation.<sup>29</sup>

**Other Measures:**

Several other measures have been identified in the literature.<sup>30</sup> Those with promising results include revised ventilator tubing management, attention to handwashing and using clean gloves as an additional barrier to conducting bacteria to the airway and lungs. Early tracheostomy has also been proposed as a measure to decrease VAP.<sup>31</sup>

The most promising measure to decrease VAP is mobilizing ventilator-dependent patients.

**Immobility: Clinical Issues**

In the early days of mechanical ventilation, patients on a ventilator were dangled on the side of the bed or up in the bedside chair. As ventilator modes evolved, higher levels of sedation were required, and better pharmacologic agents were developed. A new pathology has emerged as a consequence: critical illness polyneuromyopathy (CIPM).<sup>32,33</sup> The clinical presentation of CIPM includes deconditioning, impaired exercise tolerance & persistent weakness, long after hospital discharge.<sup>34</sup> One study showed only 49% of patients returned

**Table 2**

Stages of Early or Progressive Mobilization:
• Elevation of the head of the bed
• Continuous lateral rotation therapy (CLRT)
• Manual turning
• Passive and active range-of-motion exercises
• Movement against gravity
• Upright/leg-down position (tilt table and bed egress)
• Chair position
• Dangling
• Ambulation

to work at 1 year.<sup>35</sup>

Specific to the respiratory system, immobility leads to decreased respiratory motion, compression atelectasis, and decreased movement of secretions. Contrary to what you would expect, weakened muscles create an increased oxygen demand. The weakened lungs need to provide more oxygen to the muscles because they are unable to use it efficiently. The muscles used for respiration also become weaker and present challenges to weaning.<sup>36</sup>

**What is Early Mobilization?**

Over the last few years, the critical care community has turned their attention to increasing mobilization of ICU patients. After Dr. Needham published his work on walking ventilator patients,<sup>37</sup> getting patients out of bed became the focus for many units.<sup>38,39</sup>

“Progressive mobility” is another term used. Kathleen Vollman defines progressive mobility as “a series of planned movements in a sequential manner beginning at a patient’s current mobility status with a goal of returning to his/her baseline.”<sup>40</sup> This definition focuses on “the patient’s current mobility status” and allows for the most critical patients to be considered for the program. It also sets the realistic goal of returning the patient to their baseline, which is more realistic than attempting to walk every patient. Using this definition, a mobility program begins with elevation of the HOB and progresses through continuous lateral rotation therapy (CLRT), manual turning, passive ROM and movement against gravity, and eventually dangling and ambulation (Table 2). Patients who are critically ill and hemodynamically unstable will not tolerate being up in the chair position, but mobilizing the patient to the fullest extent possible will decrease the incidence of conditions known to affect this population as well as the long-term complications of immobility (Table 3). CLRT alone has demonstrated decreased ventilator time, LOS and incidence of VAP.<sup>41,42</sup> Because it is not well-tolerated by awake patients, it may be best for sedated patients or patients with a high BMI who are difficult to mobilize.<sup>4,43</sup>

**Is Early Mobilization Safe?**

When initiating a progressive mobility program, the first question that comes to mind is: Is it safe for my patient? Studies have reported from 1%



Figure 1. Endotracheal Tube Holder (Dale Medical Products)



Figure 2. NG Tube Holder (Dale Medical Products)

to 4.3% of patients experiencing serious adverse events due to getting the patient out of the bed. The most common complications were fall to the knees, a drop in systolic blood pressure to less than 90 mmHg, and oxygen saturations declining to less than 80%. Other less common adverse events included increases in heart rate, respiratory rate, and blood pressure, removal of the patient's feeding tube and ETT extubations.<sup>44-49</sup> Patients should be monitored for these signs and symptoms of intolerance while mobilizing.<sup>32</sup>

The most troublesome of the less lethal adverse events is tube dislodgement/extubation. This includes removal of the ETT, as well as the nasogastric tube, and urinary catheter. Reinsertion of any tube increases the patient's risk for infection and other complications. The best way to prevent dislodgement as well as other complications of indwelling tubes is to promptly remove them when no longer needed. This is not possible for most critically ill ICU patients. If the patient continues to require the invasive device, the nurse should make sure the device is secured appropriately (Figure 1).

Numerous devices are available to provide security of the device as well as access for hygiene to prevent infections. Unlike traditional securement methods (tape), the new devices provide increased clinical advantages. Most devices are quick and easy to apply and reapply. The material is breathable and the backing is designed for longer wear and to decrease skin irritation. Removal of a nasogastric (NG) tube has been reported at a rate of up to 40%<sup>50-52</sup> and is particularly troublesome for ventilator patients. If the tube is partially dislodged, the feeding may be delivered into the esophagus or trachea, causing aspiration and increasing the patient's risk for VAP. Dislodgement of the tube also means interruption in the patient's nutrition, which compounds with immobility to weaken the muscles, making it more difficult for the patient to participate in a mobilization program. (Figure 2)

According to the CDC, Catheter-associated urinary tract infections

## Numerous devices are available to provide security of the device as well as access for hygiene to prevent infections.

or CAUTIs are the most common healthcare associated infection (HAI). (CAUTI Guideline Quick Facts, available at [http://www.cdc.gov/hicpac/CAUTI\\_fastfacts.html](http://www.cdc.gov/hicpac/CAUTI_fastfacts.html)) Urethral trauma caused by insertion of multiple catheters and movement of improperly secured foley catheters has been implicated as a cause for CAUTIs. Because of this, the CDC recommends securing indwelling urinary catheters after insertion (Category 1B) in their 2009 guidelines. (HIPAC 2009 CAUTI Guidelines available at <http://www.cdc.gov/hicpac>)

There are ETT holders which provide a firm channel to prevent kinking and flattening of the tube and minimize movement while allowing the tube to be comfortably moved for oral care. Nasogastric tube holders are available in many varieties. Some

have dual tab split design which allows the device to be wrapped around the tube for more security. Stabilization devices for urinary catheters are available as both leg straps and adhesives. The use of a leg strap versus an adhesive device is still under investigation. There have been no documented cases of deep vein thrombosis from leg straps, and some sources prefer this method because it is felt the adhesive damages the latex or silicone of the catheter.

Although not a safety issue, pain can be a deterrent to patient mobilization. Cheifetz et al (2010) used an elasticized binder to support patients post-operatively to decrease pain and increase mobility in patients post major abdominal surgery.<sup>53</sup> Improvement in walk distance at post-op day 5 and perception of pain was significantly lower in the group using the binder compared to the control group. As expected after abdominal surgery, both groups had equal decreases in pulmonary function. However, use of the elasticized binder did not increase pulmonary complications. This may be a promising adjunct for incisional support and abdominal tube securement when mobilizing patients after abdominal surgery.

### Designing a plan for your unit:

If you are looking to begin a mobility program for your unit, there are many examples in the literature.<sup>54-56</sup> Your group can either adopt one or combine aspects of several that you feel will work best with your unit. The AACN has developed a "Roadmap for Implementing Change" to assist. This tool is available free on their website under the "Change Implementation Tools" section.<sup>8</sup> Their tool consists of 5 steps: Unit and Staff Assessment, Determining your Change Strategy, Measuring Success, Disseminating Findings and Celebrating Success. Let's look at each step and apply it to the process of implementing a mobility program.

### Unit and Staff Assessment (from AACN or Design your Own)

You cannot determine where you are going and how you are going to

**Table 3**

#### Benefits of Early Mobilization:

- Promote mechanical ventilator weaning process
- Reduce ICU and hospital LOS
- Prevent physical deconditioning
- Prevent ventilator-associated pneumonia (VAP)
- Prevent pressure ulcers
- Maintain/achieve preadmission activity level
- Enhance patient physical and psychological well being
- Prevention of VAP semirecumbent position with a goal of 45 degrees should be recommended in patients without contraindications.

get to your goal if you don't know where you are starting from. So, the first step is to assess your unit and staff for their current knowledge level as well as their readiness for change. This seems like an easy step, but in actuality, you are dealing with the ingrained culture of the unit and each individual nurse and respiratory therapist. Over the years, critical care nurses and respiratory therapists have gotten comfortable with caring for sedated, well-controlled ventilated patients. The idea of maintaining minimal sedation for a ventilated patient does not fit with the cultures of some ICUs.<sup>57</sup>

When performing your assessment, consider your unit's leadership and structure as well as the staff's current knowledge of the problem. Do the unit manager, physicians and other authority figures support the implementation of a mobility program? Are there other priorities that may interfere with implementation? Have there been past experiences that may affect implementation? What does the staff know about the problem? Do they identify there is a problem within the unit? These are all questions that need to be answered.

Some of the answers may be obvious, but be careful in making assumptions. Formal tools are the best way to assess the current knowledge and practice level. Using a gap analysis tool, staff survey or quality data will help with the assessment. Don't forget to include all of the stakeholders, including members of the multidisciplinary team. Planning should not be solely at the administrative level, but should include bedside practitioners from nursing, respiratory therapy and physical therapy. These staff are key to determining the best implementation strategy and will be your champions of change. On the other hand, if you are a staff member, engaging unit leadership's support and input will be invaluable in overcoming barriers to your intended change.

### Determine Change Strategies

Once you have assessed your unit, the team needs to come together to evaluate the results and create a plan for implementation. Remember to include all disciplines and levels (leadership and bedside staff) in the evalua-

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## When performing your assessment, consider your unit's leadership and structure as well as the staff's current knowledge of the problem.

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tion and planning. If you are new to the process, you may want to request help from a quality improvement professional. The starting point for change will be determined by the assessed readiness level. If the level is low, you will need to raise the awareness of the staff prior to implementing education. If the staff is aware of the need to change, your plan can start with education. For a highly engaged staff, you can begin by implementing the change.

There are many models to use to introduce change to unit and organization. Discussion of each is beyond this article. Gawlinski & Rutledge (2008) present a good overview of some models in their article and it is worth reading if you are unfamiliar with change models.<sup>58</sup>

The starting point will be determined by your assessment findings. You may have to start by raising the awareness in the unit that a change is needed. This may be enough to stimulate a change. Once staff are aware of the need to change, they need to be educated on the plan. Again, it is important to include all of the stakeholders who will influence implementation. When we implemented our plan, we educated both nurses and respiratory therapists together. Leadership from both departments taught the mandatory session. Using computer-based learning as well as posters, lunch and learn sessions and updates during staff meetings and practice council

meetings reinforces initial sessions.

Now that the staff has been educated and are motivated to change, it's time for implementation. This is not a task for one person. A multidisciplinary team with unit and leadership champions needs to be leading the change.<sup>57</sup> Be careful to provide a means for continual feedback so barriers to implementation that surface during implementation can be identified and removed. Ongoing audits need to be put in place to assess compliance with the change and educational reinforcement after initial implementation aids adoption.

Some of the roadblocks we encountered were the level of sedation the patient was ordered for, the charting in the EMR, orders for activity level and PT consult, and the lack of equipment. By working with the physicians and pharmacist on the team, we changed the sedation order set to emphasize pain control and intermittent dosing of sedatives as well as giving the nurse control over the sedation goal. An order to "mobilize as tolerated" was also added, but was rarely chosen by the ordering physician. The monthly rotation of medical residents unfamiliar with the mobility program created the consult roadblock. Through the critical care committee, we were able to implement a mobility protocol giving the nurse the ability to change the patient's order for mobility as well as initiate a consult for physical therapy when the patient met criteria.

### Measure Success

Just as much as you want to know where you started, you want to know if you have made a change. To measure the success of your program, you need to select outcomes that are measureable and meaningful. On the other hand, you also want to choose measurements that are easily attainable. In other words, if you can find measures that are already being collected by someone else, use them! Examples of measures used in the literature include ventilator length of stay, ICU length of stay, VAP rates, falls and pressure ulcers. Looking at the quality measures reported by your facility will help you determine what will work for your unit.

Continuing audits of patient level of sedation, activity level and PT consults as well as sessions are other measures that can be considered. Putting in place measures that specifically document adherence to your mobility plan will help sustain the change over time.

### Disseminate Findings

If your program is successful, don't keep your victory to yourself. Brag about your unit. Find outlets to share your plan and results with other units. This can be in the form of an article in the hospital newsletter or a presentation within your hospital at a nursing summit, but don't limit yourself. Local and national conferences offer an avenue to disseminate your findings through poster and podium presentations. Look for announcements calling for abstract submissions and submit your work.

### Celebrate Success

Finally, you've worked hard to create a better environment for your patients, so celebrate. It's your plan, so decide what is appropriate for your unit. Your champions and staff should have input into planning the celebration and the scale should match the scale of your success.

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*Perspectives* is an education program distributed free of charge to health professionals. *Perspectives* is published by Saxe Healthcare Communications and is funded through an educational grant from Dale Medical Products Inc. *Perspectives'* objective is to provide health professionals with timely and relevant information on postoperative recovery strategies, focusing on the continuum of care from operating room to recovery room, ward, or home.

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### Learning Objectives

After reading these articles, the learner should be able to:

1. Compare the evidence supporting the bundle elements recommended for reducing VAP in the ICU patient
2. Describe the modalities referred to as early mobilization
3. Discuss early versus late complications
4. Describe methods to secure a tracheostomy tube
5. Discuss how morbid obesity increases the risk of accidental cannulation

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### Faculty Disclosures

Nurse Planner: Lisa Caffery, MS, RN, CIC disclosed no conflicts of interest.

Content Experts: Lois Andrews MSN, RN-BC, CCRN, ACNS-BC; John Davies, MS, RRT, FAARC disclosed no conflicts of interest.

1. **The bundle element most supported in the literature to prevent VAP is:**
  - A. Oral care
  - B. Ventilator circuit management
  - C. Head of bed elevation
  - D. Readiness to wean or sedation vacation
2. **True or False: Microaspiration can be defined as gastric contents leaking between the esophagus and the trachea.**
  - A. True
  - B. False
3. **Using commercial tube holders instead of tape eliminates which barriers to oral care?**
  - A. Fear of dislodging the tube
  - B. Perceived discomfort
  - C. Time & personnel needed
  - D. All of the above
4. **Which of the following techniques are considered part of "progressive mobility"?**
  - A. Dangling on the side of the bed
  - B. Ambulation
  - C. Continuous lateral rotation therapy (CLRT)
  - D. All of the above
5. **A common avoidable, non –life threatening consequence of increasing mobility is:**
  - A. Tube dislodgement
  - B. Hypotension
  - C. Syncope
  - D. Desaturation
6. **According to the AACN Model, the first step to implementing a change in your unit is to:**
  - A. Choose a change model
  - B. Find a physician champion
  - C. Adopt a protocol from the literature
  - D. Assess your unit and staff
7. **Indicate which of the following is/are late complications of tracheostomy:**
  - A. Tracheal stenosis
  - B. Granulation tissue
  - C. Tracheoinnominate fistula
  - D. All of the above
8. **Early complications of tracheostomy include:**
  - A. Hemorrhage
  - B. Tube dislodgement
  - C. Tracheoinnominate fistula
  - D. A + B
9. **When will symptoms from tracheal stenosis appear clinically when the tracheal lumen is reduced:**
  - A. 10% - 25%
  - B. 25% - 50%
  - C. 50% - 75%
  - D. 75% - 100%
10. **Morbidly obese patients are at a greater risk of developing all of the following complications except:**
  - A. Tracheoinnominate fistula
  - B. Airway obstruction
  - C. Accidental decannulation
  - D. Inability to re establish a patent airway

Participant's Evaluation	Questions																																																																																										
<p><b>This test must be taken online at <a href="http://www.saxetesting.com">www.saxetesting.com</a></b></p> <p><b>Once completed, you may print out your certificate immediately</b></p> <ol style="list-style-type: none"> <li>1. Using your browser, Please go to <a href="http://www.saxetesting.com/p/">http://www.saxetesting.com/p/</a></li> <li>2. On your left login with your username and password and click submit.(if this is your first time, you must register by clicking the register link) If you have forgotten your username or password, you can request a reminder. An email be sent to you with your username/password in it.</li> <li>3. You may now take your test.</li> <li>4. After sucessfully completing your test, you will be asked to take a small survey. (this is a requirement of the accreditation process).</li> <li>5. After completing this survey, click the "Print Certificate " button to print out your certificate of completion</li> <li>6. If you are having difficulty, please download our FAQ at <a href="http://www.saxetesting.com/faq">http://www.saxetesting.com/faq</a></li> </ol>	<p><b>Answer worksheet</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <table style="width: 100%; border: none;"> <tr> <td style="width: 25%; text-align: center;">A</td> <td style="width: 25%; text-align: center;">B</td> <td style="width: 25%; text-align: center;">C</td> <td style="width: 25%; text-align: center;">D</td> </tr> <tr> <td>1 <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table> </td> <td style="width: 50%; border: none;"> <table style="width: 100%; border: none;"> <tr> <td style="width: 25%; text-align: center;">A</td> <td style="width: 25%; text-align: center;">B</td> <td style="width: 25%; text-align: center;">C</td> <td style="width: 25%; text-align: center;">D</td> </tr> <tr> <td>6 <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table> </td> </tr> <tr> <td style="border: none;"> <table style="width: 100%; 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