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Institute for Healthcare Improvement
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Ventilator Bundle (IHI Tool)

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Ventilator Bundle

What is your goal?

To improve performance on the ventilator bundle.

How will you know when you reach your goal?

Monitor performance on the ventilator bundle using the DAILY GOALS SHEET.

What will you do to reach your goal?

1. Improve education by distributing a FACT SHEET and hold in-services for bedside providers.
2. Improve communication among providers by using the DAILY GOALS SHEET during rounds in the ICU.
3. Create independent redundancy to insure that patients receive the process of care included in the ventilator bundle.

PDSA 1. STAFF EDUCATION

TIME LINE: _____

PLAN: Based on a staff survey, we found that bedside providers did not know that the processes of care within the ventilator bundle can dramatically improve patient outcomes. A FACT SHEET will increase knowledge and improve performance on the ventilator bundle.

DO: 1. Calculate the opportunity to improve from baseline data:
Use these estimates to complete the FACT SHEET for your ICU.

2. Distribute the completed FACT SHEET to all staff members. Consider in-services for the providers to read the FACT SHEET and ask questions.

3. Consider using a brief quiz to test the provider's knowledge after the FACT SHEET is distributed.

STUDY: Once a week for two consecutive weeks, determine the number of providers that have received the FACT SHEET and/or completed the quiz.

ACT: Make the results of the study known to providers. If <90% of providers received the FACT SHEET and/or completed the quiz, plan a meeting with your team to evaluate additional opportunities to increase knowledge among providers.

FACT SHEET
ICU Process Measures

For mechanically ventilated patients:

- Head of bed (HOB) elevation ≥30 degrees reduces the frequency and risk for nosocomial pneumonia compared to supine position.
- The use of thromboprophylaxis is effective for preventing deep venous thrombosis (DVT).
- The use of peptic ulcer disease (PUD) prophylaxis reduces the risk of upper gastrointestinal bleeding.
- Daily interruption of sedative drug infusions decreases the duration of mechanical ventilation and length of stay (LOS) in the ICU.
- Intensive insulin therapy to maintain blood glucose ≤110 mg per deciliter reduces morbidity and mortality among critically ill patients.
- Daily screening of the respiratory function followed by trials of spontaneous breathing can reduce the duration of mechanical ventilation, decrease complications and costs of ICU care.

Based on our current performance, our opportunity to improve the care that we provide to patients :

Quality Measure	Adverse Events	Costs
Elevate HOB	xx deaths xx hospital days	$xx
DVT prophylaxis	xx deaths xx hospital days	$xx
PUD prophylaxis	xx deaths xx ICU days	$xx
Appropriate Sedation	xx ICU days	$xx
Total		

HEAD OF BED ELEVATION:

Bottom Line: In mechanically ventilated patients, head of bed (HOB) elevation ≥30 degrees reduces the frequency and risk for nosocomial pneumonia compared to supine position. Elevating the HOB ≥30 degrees is a simple no-cost intervention that will improve outcomes in our patients.

The evidence supporting this therapy is from a study of patients who are mechanically ventilated in ICU. The incidence of aspiration was reduced from 38% in the supine group to 8% group with HOB elevation. Days on the ventilator and ICU length of stay were also reduced.

What is the opportunity to improve?
In our ICU, xx% of patients on mechanical ventilation had their HOB elevated ≥30 degrees.

Mean performance on elevating the HOB	Excess ventilator-associated pneumonias per year	Excess deaths per year	Excess hospital days per year	Excess cost per year
xx%	xx	xx	xx	$xx

*assumes xx admissions per year in our ICU

If we can reach our goal of 100%, we may be able to prevent xx ventilator-associated pneumonias per year with this simple intervention. If we assume that ventilator-associated pneumonia increases the risk for in-hospital mortality by 40% and hospital length of stay (LOS) by 2 weeks, this would lead to xx excess deaths and xx additional hospital days per year in the ICU. If the marginal cost of an additional hospital day is $600, there would have been $xx in excess costs. By elevating the head of bed for patients who are mechanically ventilated, we can reduce their risk for a ventilator-associated pneumonia and the ensuing morbidity and mortality.

APPROPRIATE DVT PROPHYLAXIS:

Bottom Line: In critically ill patients thromboprophylaxis is effective for preventing deep venous thrombosis (DVT). However, the method of prophylaxis proven in one group of patients cannot necessarily generalize to other patients, and multiple types of thromboprophylaxis appear to be effective. Nonetheless, there is agreement that patients who are critically ill or mechanically ventilated are at high risk for DVT and should receive thromboprophylaxis.

Perhaps the best summary of this evidence comes from a recent review in critically ill patients admitted to medical and surgical ICUs. Multiple therapies for DVT prophylaxis were consistently reported to reduce the risk of DVT in critically ill patients. The effective therapies include unfractionated heparin, heparin, and mechanical prophylaxis such as with TED hose or sequential compression devices. Nonetheless, the studies varied in the populations they studied.

One of the important messages of these types of studies is that all of the therapies appear to be effective, and it is generally more important to use a therapy than to focus on a specific therapy.

What is the opportunity to improve?
In our ICU, xx% of patients on mechanical ventilation had DVT prophylaxis. Our goal should be 100%.

Mean performance on use of DVT prophylaxis	Excess DVTs per year	Excess deaths per year	Excess hospital days per year	Excess costs per year
xx%	xx	xx	xx	$xx

*assumes xx admissions per year in the ICU

Let's assume that DVT prophylaxis results in a 50% relative risk reduction in the incidence of DVT. Although the baseline incidence varies among groups, in most studies of critically ill patients, the baseline incidence of DVT was 30%; a 50% reduction would decrease this incidence to 15%. In addition, let's assume that thromboembolic events are associated with a 15% increased risk for in-hospital mortality and increase hospital LOS by 9 days. In our ICU, there were an additional xx DVTs, xx deaths, and xx hospital days per year because of the failure to use thromboprophylaxis. Assuming the marginal cost of an additional hospital day is $600, there was $xx in excess costs per year. This represents a significant opportunity for us to improve.

APPROPRIATE PUD PROPHYLAXIS:

Bottom Line: In mechanically ventilated patients the use of PUD prophylaxis reduces the risk of upper gastrointestinal (GI) bleeding.

Mechanically ventilated patients have an increased risk for upper GI bleeding and the evidence supports prophylaxis in these patients. In a study published by Cook in the *New England Journal of Medicine*, investigators found two important risk factors for gastrointestinal bleeding: mechanical ventilation >48 hours and coagulopathy. The specific therapy may be less important. Multiple therapies for PUD prophylaxis are effective. For patients who are not mechanically ventilated, the literature regarding the need for PUD prophylaxis is controversial.

What is the opportunity to improve?
In our ICU, xx% of patients on mechanical ventilation had PUD prophylaxis. Our goal should be 100%.

Mean performance on use of PUD prophylaxis	Excess episodes of GI bleeding per year	Excess deaths per year	Excess ICU days per year	Excess costs per year
xx%	xx	xx	xx	$xx

*assumes xx admissions per year in our ICU

In our ICU, this would translate into xx episodes of significant upper GI bleeding due to the failure to use appropriate PUD prophylaxis. If we assume that GI bleeding results in an additional 5-day LOS, and the cost of an ICU day is $1,200, our ICU would have had an additional xx ICU days and $xx in excess costs due to the failure to use appropriate PUD prophylaxis. There is also an estimated 13% relative increase in mortality associated with significant upper GI bleeding in the ICU.

APPROPRIATE SEDATION:

Bottom Line: Daily interruption of sedative drug infusions decreases the duration of mechanical ventilation and length of stay (LOS) in the ICU.

The evidence supporting this measure comes from a study where patients were randomized to have their sedation held daily until they were able to follow commands, or they became uncomfortable and agitated, or they were able to have routine care. The study found that in the group that had daily interruption of sedation, the duration of mechanical ventilation was reduced by 33% and ICU LOS was reduced by 35%. Translating these results into days, the average duration of mechanical ventilation was reduced an average of 2.4 days and the ICU LOS was reduced 3.5 days.

This study demonstrates the dramatic reduction in both mechanical ventilation and ICU LOS that can be achieved when patients are sedated such that they are able to follow commands daily.

What is the opportunity to improve?

In our ICU, xx% of patients on mechanical ventilation had sedation held until they were able to follow commands.

Mean performance of appropriate sedation	Excess days of mechanical ventilation	Excess ICU days	Excess costs in dollars
xx%	xx days	xx days	$xx

*assumes xx admissions per year in our ICU

When this approach is not followed, patients have an increase of 2.4 days of mechanical ventilation and an increase of 3.5 ICU days. Using the mean performance in our ICU, we would have an annual excess of xx days of mechanical ventilation, xx ICU days, and $xx in excess costs.

APPROPRIATE GLUCOSE CONTROL:

Bottom Line: Intensive insulin therapy to maintain blood glucose ≤110 mg per deciliter reduces morbidity and mortality among critically ill patients.

The evidence supporting this measure comes from a study where mechanically ventilated patients were randomized to receive intensive insulin therapy (maintenance of blood glucose at a level between 80 and 110 mg per deciliter) or conventional treatment. They found that in the group that had glucose levels ≤110 mg per deciliter (mg/dl), in-hospital mortality decreased by 34% and 12-month mortality decreased by 43%. Rates of infection and acute renal failure were also decreased among patients that had glucose levels ≤110 mg/dl.

This study demonstrates the dramatic reduction in morbidity and mortality that can be achieved when we maintain patient glucose levels ≤110 mg/dl.

What is the opportunity to improve?

We currently do not have baseline rate for this measure in our ICU. We will be collecting data to determine the opportunity to improve the care that we provide to our patients.

ASSESSMENT OF READINESS TO EXTUBATE:

Bottom Line: Daily screening of the respiratory function followed by trials of spontaneous breathing can reduce the duration of mechanical ventilation, and decrease complications and costs of ICU care.

The evidence supporting this measure comes from a study where mechanically ventilated patients in medical and coronary care ICUs were randomized to receive daily screening of respiratory function. Patients that passed the screening test received a two-hour trial of spontaneous breathing. Physicians were notified when their patients successfully completed the trial of spontaneous breathing. The control subjects had daily screening only. They found that in the group that had daily screening followed by a spontaneous breathing trial, the duration of mechanical ventilation was 1.5 days less (4.5 days versus 6 days). Complications — removal of the breathing tube by the patient, reintubation, tracheostomy, and mechanical ventilation >21 days — occurred in 20% of the intervention group and 41% of the control group. Total costs were also lower in the intervention group.

This study demonstrates the dramatic reduction in morbidity and mortality that can be achieved when we assess readiness for extubation daily.

What is the opportunity to improve?

We currently do not have baseline rate for this measure in our ICU. We will be collecting data to determine the opportunity to improve the care that we provide to our patients.

References:

Kress JP, Pohlman AS, O'Connor MF, Hall JB. Daily interruption of sedative infusions in critically ill patients undergoing mechanical ventilation. *New England Journal of Medicine*. 2000;342(20):1471-1477.

Drakulovic MB, Torres A, Bauer TT, Nicolas JM, Nogue S, Rerrer M. Supine body position as a risk factor for nosocomial pneumonia in mechanically ventilated patients: A randomized trial. *Lancet*. 1999; 354(9193):1851-1858.

Burns SM, Egloff MB, Ryan B, Carpenter R, Burns JE. Effect of body position on spontaneous respiratory rate and tidal volume in patients with obesity, abdominal distention, and ascites. *American Journal of Critical Care*. 1994;3(2):102-106.

Torres A, Serra-Batlles J, et al. Pulmonary aspiration of gastric contents in patients receiving mechanical ventilation: The effect of body position. *Annals of Internal Medicine*. 1992;116(7):540-543.

Byers JF, Sole ML. Analysis of factors related to the development of ventilator-associated pneumonia: Use of existing data bases. *American Journal of Critical Care*. 2000;9(5):344-349, quiz 351.

Cook DJ, Fuller HD, et al. Risk factors for gastrointestinal bleeding in critically ill patients. Canadian Critical Care Trials Group. *New England Journal of Medicine*. 1994;330(6):377-381.

Attia J, Ray JG, Cook DJ, et al. Deep vein thrombosis in critically ill adults. *Archives of Internal Medicine*. 2001;161(10):1268-1279.

Hebert PC, Wells G, Blajchman MA, et al. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. *New England Journal of Medicine*. 1999;340(6):409-417.

van den Berghe G, Wouters P, Weekers F, et al. Intensive insulin therapy in the critically ill patients. *New England Journal of Medicine*. 2001;345(19):1359-1367.

Ely EW, Baker AM, et al. Effect on the duration of mechanical ventilation of identifying patients capable of breathing spontaneously. *New England Journal of Medicine*. 1996;335(25):1864-1869.

PDSA 2. DAILY GOALS SHEET

TIME LINE: _____

PLAN: Implement DAILY GOALS SHEET to enhance communication among providers and improve compliance with the ventilator bundle.

DO: Complete the DAILY GOALS SHEET on each patient during morning rounds. The completed form is reviewed and initialed by the ICU attending or fellow and left at the patient's bedside. Consider placing the SHEET on a wall-mounted clipboard in a visible location at the patient's bedside. Any changes in the plan of care for the day should be documented on the DAILY GOALS SHEET. Providers review and initial the SHEET three times during the course of the day to ensure that the plan is up-to-date and complete.

STUDY: Once a week for two consecutive weeks, determine the number of patients that had the DAILY GOALS SHEET completed.

ACT: Make the results of the study known to providers. If <100% of patients had completed DAILY GOALS SHEETS, plan a meeting with your team to evaluate additional opportunities to improve compliance with the DAILY GOALS SHEET.

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DAILY GOALS SHEET

Room Number _____ Date ____/____/_____

--Initial as goals are reviewed--

		0700-1500	1500-2300	2300-0700
What needs to be done for the patient to be discharged from the ICU?				
What is this patient's greatest safety risk?				
Neuro/ Pain Mgt / Sedation				
Cardiac / Volume status; Net goal for midnight				
Pulmonary/Ventilator (elevate HOB, glucose control, daily RSBI or SBT, weaning)				
Is this patient receiving DVT/PUD prophylaxis?				
Mobilization / OOB				
ID, Cultures, Drug levels				
GI / Nutrition / Bowel regimen				
Medication changes (Can any be discontinued?)				
Tests / Procedures today				
Review scheduled labs				
Morning labs and CXR; Critical pathway				
Consultations				
Is the primary service up-to-date?				
Has the family been updated? Have social issues been addressed?				
Can catheters/tubes be removed?				

Fellow/Attending Initials: _____

PDSA 3. CREATING SYSTEMS OF INDEPENDENT REDUNDANCY

PLAN: To incorporate reminders into the existing system and improve compliance with the ventilator bundle.

DO: Add reminders to the charting system to query the RN and/or respiratory therapist when performing ventilator documentation that reads: Is the HOB elevated ≥30 degrees? Is the patient receiving DVT prophylaxis? etc.

- Consider adding a ventilator bundle reminder to the charge nurse report form, bedside nurse report form, and respiratory therapist report form. This provides independent redundancy such that the charge nurse, bedside nurse, and respiratory therapist will be prompted to ensure compliance with the ventilator bundle.

- Consider using a preprinted set of orders for all patients being placed on mechanical ventilation. These orders would include the ventilator settings, PUD prophylaxis, DVT prophylaxis, etc.

STUDY: Monitor performance for the ventilator bundle.

ACT: Print a run chart of your performance for the ventilator bundle over time. Plan a meeting with your team to evaluate additional opportunities to improve performance.