



Daily Care Processes Guide for Reducing Ventilator-Associated Events in Mechanically Ventilated Patients

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Introduction

Improve the Care of Mechanically Ventilated Patients

Ventilator-associated pneumonia (VAP) is among the most common health care-acquired infections in the intensive care unit (ICU).¹ Approximately 10 to 20 percent of patients receiving mechanical ventilation develop VAP, and patients suffering from VAP are twice as likely to die.² According to the Center for Disease Control and Prevention (CDC), the median VAP rate among all ICU types ranges from 0.7 to 7.4 per 1,000 ventilator days.³ The attributable mortality for VAP exceeds 10 percent⁴ or 36,000 deaths per year.⁵ The average increase in length of stay is 4–9 days for patients suffering from VAP.⁴ VAP is the most significant independent risk factor for mortality among all ICU patients, with an increased hazard ratio in the cardiac surgery population of almost 9 percent.⁶ Nevertheless, the true incidence and attributable morbidity and mortality of VAP have been difficult to determine because traditional surveillance definitions are highly subjective.⁷

In 2013, the National Healthcare Safety Network (NHSN) at the CDC changed its surveillance definition from VAP to ventilator-associated events (VAE).⁸ VAE surveillance includes a wider range of preventable harms associated with mechanical ventilation, including noninfectious conditions such as acute respiratory distress syndrome (ARDS), pulmonary edema, and atelectasis.

Quality improvement programs to prevent these harms in mechanically ventilated patients are paramount. While many organizations have devoted significant resources to reducing VAP rates, many opportunities for improvement remain. Additional goals to improve care of mechanically ventilated patients include duration of mechanical ventilation, ICU and hospital length of stays, and morbidity and mortality.

In addition, hospital units can improve their culture of safety and communication. The implementation of the [Comprehensive Unit-based Safety Program](#) (CUSP) can facilitate a hospital's or unit's ability to change the culture of safety in the unit and increase an understanding of the risks for and rates of VAE. Frontline staff members often lack awareness that patients are at risk for preventable harm associated with mechanical ventilation. They may not know the risk factors associated with VAEs or even their local VAE rates. Sharing this information with frontline staff and hospital leadership engages them in improving care.

The [AHRQ Safety Program for Mechanically Ventilated Patients](#) focuses on three goals:

- Tap into the wisdom of frontline providers
- Harness the power of local data
- Get patients off the ventilator faster

This strategy reduces hospital and ICU length of stay, reduces time spent on mechanical ventilation, and ultimately eliminates VAEs, including VAP.

Changing Daily Care To Prevent the Harms Associated With Mechanical Ventilation

Prior to 2013, the CDC National Healthcare Safety Network (NHSN) surveillance for ventilator-associated complications (VAC) was limited to VAP. VAP, a heterogeneous disease, is difficult to diagnose.⁹ Radiological and microbiological methods of diagnosing VAP are notoriously subjective and difficult to perform with critically ill patients.⁹ These barriers often result in significant variability among providers and inconsistent treatment paradigms. In the United States in particular, problems in diagnosing and treating VAP stem from subjectivity in classification that leads to misdiagnosis.⁹

In January 2012, the NHSN released new surveillance definitions for VAE.¹⁰ This tiered definition is based on objective, streamlined, and automatable criteria, and is more broadly focused on preventable complications of mechanical ventilation, including VAP.¹⁰ In addition to pneumonia, VAEs are most commonly comprised of atelectasis, pulmonary edema and/or ARDS.¹¹ Furthermore, emerging data suggests that VACs are associated with prolonged mechanical ventilation, prolonged hospitalization, and increased hospital mortality.¹¹ Implemented in January 2013, the new NHSN VAE surveillance definitions marked a strong first step toward recognizing the short-term preventable complications associated with mechanical ventilation beyond VAP. It also provided a measurable tracking mechanism for these new, noninfectious, mechanically ventilated patient outcomes.

What's in the Guide?

By implementing this safety program, your team leads the national effort to reduce VAE to improve the care of mechanically ventilated patients.

However, this guide alone is not a prescription for success. While we have developed a model to support efforts to implement these evidence-based practices, reduce VAE and other harms associated with mechanical ventilation, as well as improve care for all mechanically ventilated patients, the authors of this manual do not work in your ICU or unit. Only your team understands your obstacles and your opportunities for improvement. These materials provide a structure for your efforts to implement evidence-based practice and protect your patients from VAEs. Without a doubt, success will require your creative energy, persistence, leadership, and teamwork.

Use the TRIP Model as a Framework

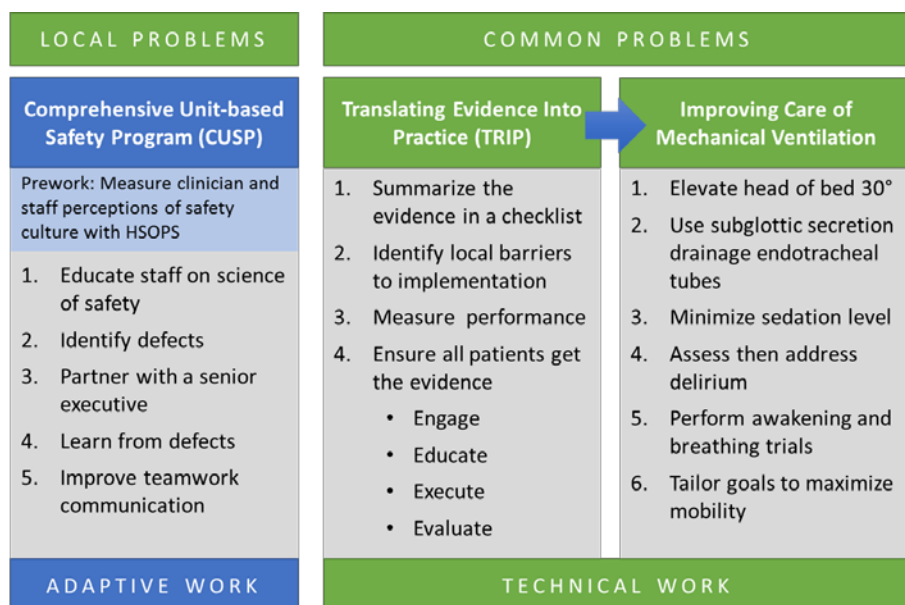
This guide’s structure is based on a model to Translate Research Into Practice (TRIP), designed to close the gap between evidence-based guidelines and bedside practice.¹²

The TRIP Model is composed of four phases:

1. Develop an evidence-based intervention
 - a. Identify interventions associated with improved outcomes
 - b. Select interventions with the largest benefit and lowest burden
2. Identify barriers to implementation
3. Measure baseline performance
4. Ensure all patients receive the intervention

Implementation of the TRIP model in combination with CUSP has been associated with significant reductions in central line-associated blood stream infections (CLABSIs)^{12,13} and VAP¹⁴ in more than 100 Michigan ICUs. The results were sustained for more than 3 years, and were associated with a reduction in mortality among Medicare patients¹⁵ and significant cost savings.¹⁶ Implementation of the same programs in Rhode Island ICUs demonstrated similar results.¹⁷ Most recently, implementation of the TRIP model in combination with CUSP has been associated with significant reductions in CLABSI in 45 States, including Hawaii and Connecticut.¹⁸ The framework in Figure 1 will help you incorporate evidence-based interventions into your patient care practices. Below, we describe each step of the TRIP model applied to improving care for mechanically ventilated patients.

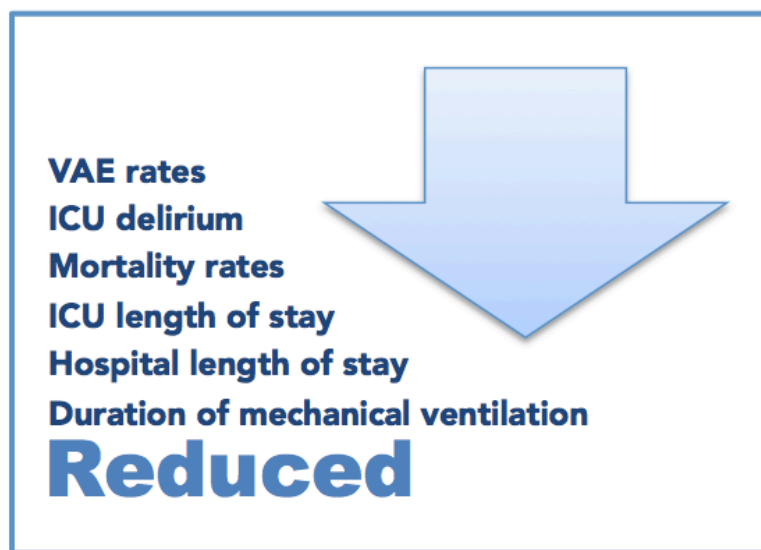
Figure 1. Model for Patient Safety Quality Improvement



Phase 1. Develop an Evidence-Based Intervention

In phase 1, you will develop an evidence-based intervention plan for your work area. Your plan will encompass two distinct processes. First, identify the interventions associated with your desired outcome improvements. Next, select those interventions with the lowest burden and largest benefit, such as the benefits shown in Figure 2 below.

Figure 1. Benefits of Daily Care Interventions



Identify Interventions Associated With Improved Outcomes

The Institute for Healthcare Improvement (IHI) Ventilator Bundle, used by most sites since its development in 2002¹⁹, was not developed with the express purpose of VAP or VAE prevention. It was developed to guide the care for mechanically ventilated patients and included interventions such as stress ulcer and deep vein thrombosis prophylaxis.

Since the development of the IHI Ventilator Bundle, four sets of national guidelines have been written regarding interventions for the prevention of VAP, including guidelines from the Centers for Disease Control and Prevention²⁰, the American Thoracic Society²¹, the Society of Healthcare Epidemiology of America²², and the Canadian Critical Care Trials Group from the Canadian Critical Care Society.²³

Following a thorough review of these guidelines and literature published after the guidelines (post 2007), we identified 65 possible interventions for VAP prevention. To determine which candidate interventions to include in a new comprehensive bundle focused on VAP prevention, we assembled a VAP Prevention Committee of 155 health care experts in the care of patients on mechanical ventilation. Committee members participated in a modified Delphi process to determine the most important interventions to be considered for inclusion in an updated VAP Prevention Bundle.

Nineteen interventions were chosen for inclusion in the bundle. These interventions were divided into two groups: care compliance monitored daily and organizational policy changes. The daily care measures include interventions directly related to the care of mechanically ventilated patients. Adherence to daily care measures may vary from day to day, including head of the bed elevation to at least 30 degrees, the use of subglottic secretion drainage endotracheal tubes (SSD-ETT) for patients requiring mechanical ventilation for more than 72 hours, oral care, oral care with chlorhexidine, and daily spontaneous awakening trials and spontaneous breathing trials (SAT and SBT). The remaining 14 interventions are policy or structural measures at the hospital and specific unit. These can include such policies as assuring that noninvasive ventilator support is available at all times and that caregivers know when and how to use it. While the policy (or structural) interventions can affect the patient's care on a daily basis, adherence is unlikely to vary day to day if effective unit/hospital policies and procedures are in place.

Subsequent to the development of these measures, the NHSN at the CDC changed its surveillance definition from VAP to VAE. As previously mentioned, the VAE definition focuses on the broader set of preventable harms associated with mechanical ventilation, and not just VAP. In consideration of this change, our attention turned to the daily interventions that reduce risk of this broader set of preventable harms, while remaining aligned with our overall goal to decrease the duration of mechanical ventilation.

These interventions form the basis for the [Daily Care Processes Data Collection Tool](#):

- **Use a semirecumbent position while patients are in bed (≥ 30 degrees from the horizontal).** The elevation of the head of the bed to a semirecumbent position (≥ 30 degrees) is associated with a decreased incidence of aspiration and VAP.
- **Use SSD-ETT for patients expected to be ventilated for more than 72 hours.** The use of these special endotracheal tubes is associated with a 50 percent reduction in VAP rates. Their use also has been shown to be cost effective.
- **Target a sedation level and perform a structured assessment of sedation level using a validated sedation scale** (e.g., Richmond agitation sedation scale [RASS] or Riker sedation-agitation scale [SAS]). Set a target sedation goal of no or light sedation and work to achieve that level. Pair this effort with the SAT and SBT to get your patients off the ventilator faster.
- **Perform a structured assessment of delirium level using a validated delirium assessment scale** (e.g., Confusion Assessment Method for the ICU [CAM-ICU] or the Intensive Care Delirium Screening Checklist [ICDSC]). Routinely assessing the patient's cognitive function with these scales will help you target lighter sedation levels, and identify and appropriately treat delirium. If the use of a validated scale is not feasible on your unit, consider using the Attention Screening Exam (ASE), Part 2 of the CAM-ICU.
- **Minimize sedative use and perform a daily sedation interruption or vacation, or SAT.** This will help you achieve the goal of minimum or light sedation, and ready the patient for the spontaneous breathing trial (SBT).

- **Evaluate readiness for discontinuation of mechanical ventilation with daily coordinated SATs and SBTs.** This allows a more accurate assessment of the patient’s readiness for extubation. It is important to assure the patient is undergoing an SAT at the same time as the SBT for a best-case evaluation of readiness for extubation.
- **Coordinate a multidisciplinary approach.** In order to facilitate these interventions, the joint participation of nurses, physicians, respiratory therapists, rehabilitation therapists, and local hospital and unit administrators is vital. Throughout the CUSP and TRIP model continuum, interdisciplinary teams are required to create a culture focused on providing the best possible care for mechanically ventilated patients.

The provision of oral care with and without chlorhexidine is not a key intervention for the following two reasons:

- Recently published literature questions the efficacy of oral care with chlorhexidine in preventing VAP.²⁴
- Performing and documenting oral care requires significant resources better focused on interventions known to decrease the duration of mechanical ventilation and ICU and hospital length of stay.²⁴

The AHRQ Safety Program for Mechanically Ventilated Patients prioritizes evidence-based interventions more likely to get patients off the ventilator faster. More information is available in a later section, “Execute: How Will We Reduce VAE Given Local Culture and Resources?”

Select Interventions With the Largest Benefit and Lowest Burden

Where do we start? At the beginning of the project, most of your efforts will be spent developing a team that includes all players involved in the care of mechanically ventilated patients: nursing, respiratory therapy, physicians, and others. While there is no formula to select which intervention(s) to focus on in the beginning, your team will want to consider a few factors:

- How much effort is required to build buy-in for the intervention?
- Who will champion this effort?
- How should we share the evidence supporting the intervention to the different stakeholders?
- Which resources are required to change current local practice?
- What is required to garner the necessary resources?

Consider choosing some *low-hanging fruit* to gain positive momentum before focusing on the more challenging interventions. “Low-hanging fruit” indicates an intervention that is easy to implement but yields strong rewards. For instance, it would be easier to add a nightlight to bathrooms before redesigning floor plans to reduce patient falls.



Daily Care Processes in Practice

“Our process for weaning patients off the ventilator was haphazard and poorly documented. We decided to focus on standardizing the performance of SAT and SBT for all patients on a daily basis. Evidence suggests that patients are weaned faster using nursing and respiratory therapist-driven protocols. Nursing leadership worked with the nursing staff, respiratory therapists, and the ICU physicians to devise screening algorithms and protocols that paired SAT with SBT. These were automatically carried out on every ICU patient every morning prior to rounds, and the nursing staff documented the result in the electronic health record. In addition, the nursing staff articulated the results of the screening, and SAT and SBT on rounds to facilitate earlier physician decisions regarding extubation.”

–Safety Program Team Member

Phase 2. Identify Barriers to Implementation

Clinicians want to achieve the best possible outcomes for their patients. If patients are not receiving the evidence-based intervention your team identified, you will need to understand the barriers to compliance.²⁵ Barriers to implementation of evidence-based interventions commonly fall into three categories, the three As:

- **Awareness:** Are clinicians aware of the evidence-based intervention?
- **Agreement:** Do clinicians agree with the intervention?
- **Access:** Do clinicians have convenient access to the equipment or supplies needed to implement the intervention?

Although they may vary between units, the most commonly encountered barriers to implementing these interventions include the following:

- **Lack of leadership:** Strong leadership is necessary both at the institutional and local levels, including the recruitment of a multidisciplinary project team.
- **Lack of institutional support:** The CUSP team needs to include an executive from the hospital’s administration. The executive can take concerns and issues back to the administration, help solve problems, and act as a resource for the implementation of hospital level changes.
- **Lack of resources:** Adequate professional staffing and equipment are necessary for successful implementation, and institutional leadership must understand the value of a program to support it.
- **Lack of clinical training:** Comprehensive education and training across disciplines is required.

- **Excessive sedation and delirium:** Patients need to wake up (SAT) and breathe (SBT) to be extubated and discharged from the unit.

Through education, engagement, and collaboration of multidisciplinary teams of clinicians, these barriers can be surmounted to focus on preventing the harms associated with mechanical ventilation and make these efforts a part of routine care.

Overcome Barriers to Compliance With Tools

The [Unit Gap Analysis Tool](#) and the [Learn From Defects Tool](#) are valuable instruments that can help you identify areas in your unit where compliance to recommended interventions may be lacking. These tools can also assist in developing action plans to improve compliance to Daily Care Process measures.

<i>Tools</i>	<i>How To Use Them</i>
Unit Gap Analysis Tool—ABCDE Bundle	The American Association of Critical-Care Nursing offers a Unit Gap Analysis tool that assesses which elements of the ABCDE bundle are in place in your unit and helps identify areas of improvement.
Learn From Defects Tool	Use this tool to lead discussions that engage frontline staff in characterizing defects, uncovering system-level causes, and developing plans for improving patient safety and quality. We recommend learning from at least one defect a quarter.



Daily Care Processes in Practice

“Realizing the importance of incorporating subglottic secretion drainage endotracheal tubes (SSD-ETT) for patients expected to be on mechanical ventilation for more than 72 hours, we chose to use these SSD-ETTs as standard of care for these patients throughout our hospital. We first met with the hospital senior leadership to discuss prioritizing the hospital-wide care improvement for mechanically ventilated patients. We shared how the use of SSD-ETTs improve patient outcomes, and presented data demonstrating their cost-effectiveness. The hospital leadership agreed to use the SSD-ETTs, and we worked to purchase and distribute them broadly throughout the hospital.

Now, SSD-ETTs are stocked in the intensive care units and on code carts at our hospital. Next, we worked with the Department of Anesthesiology to achieve the buy-in of the anesthesiologists and nursing in the operating rooms. We then engaged the operating room, emergency department, and rapid response teams. We are still working on implementing them in the other departments.”

–Safety Program Physician Champion

Phase 3. Measure Performance

Measure Baseline Performance

Collect baseline performance data to highlight at-risk areas, and the opportunities for improvement. Share your performance data with clinicians and hospital leadership to catalyze improvement efforts. Multiple strategies can help assess baseline performance and progress towards improving care for your mechanically ventilated patients. These include assessing compliance with process and policy measures, as well as formal outcome measures such as VAE and VAP rates.

Monitor Compliance With Evidence-Based Interventions

It is important to monitor compliance with evidence-based interventions through frequent formal and informal audits. Share the results from these audits with all involved staff to maintain engagement and spur improvement. Through this process you will be able to maintain awareness, establish expectations, create urgency, generate accountability, and reward changes in behavior.²⁶⁻²⁸ Evaluating performance provides an ongoing, real-time image of “ground truth” of your unit’s actual practice.²⁹ Areas of poor compliance can be rapidly identified and rectified.³⁰ Any lingering compliance concerns are immediately recognized, allowing the improvement team to revisit and address. Walk through the process with staff to gain additional insights into barriers to implementation and weak compliance rates.¹⁸

The [Daily Care Processes Data Collection Tool](#) will allow you to assess local compliance with the evidence-based daily patient care activities.

- Use a semirecumbent position while your patients are in bed (at least 30 degrees from the horizontal)
- Use SSD-ETTs for patients expected to be ventilated for more than 72 hours
- Target a sedation level and perform a structured assessment of sedation level using a validated sedation scale (i.e., RASS or SAS)
- Perform a structured assessment of delirium level using a validated delirium assessment scale (e.g., CAM-ICU or the ICDSC. If the use of a validated scale is not feasible on your unit, consider using the Attention Screening Exam (ASE), Part 2 of the CAM-ICU.
- Minimize sedative use and perform a daily sedation interruption or vacation, or SAT
- Evaluate readiness for discontinuation of mechanical ventilation with daily SBTs
- Pair the use of SAT and SBT trials to allow a more representative evaluation of the patient's readiness to extubate

Review Policy-Based or Structural Measures

Policy or structural measures evaluate the extent to which existing nursing, respiratory therapy, and/or unit or hospital policies address compliance with interventions to prevent complications for mechanically ventilated patients. Policies for many of these interventions may already be in place in your unit. However, your policies may not be up to date or may not reflect the latest evidence-based guidelines. For those items where you either don't have a policy or your policy differs from those we have listed, we suggest that you take on the process of changing these policies to help ensure the best possible care for your mechanically ventilated patients.

- Perform hand hygiene
- Avoid the supine position
- Use standard precautions while suctioning respiratory
- Use orotracheal route, not nasotracheal, for elective intubation
- Avoid the use of prophylactic systemic antimicrobials
- Avoid gastric overdistention
- Use a closed ETT suctioning system
- Change closed suctioning circuits only as needed
- Change ventilator circuits only if circuits become damaged or soiled
- Change heat moisture exchangers every 5–7 days and as clinically indicated
- Provide easy access to noninvasive ventilation equipment and institute protocols to promote use
- Remove condensate periodically from circuits, keeping the circuit drain closed during the removal and taking precautions not to allow condensate to drain toward patient

- Use an early mobility protocol

We have developed additional resources to support your implementation of early mobility: [Early Mobility Guide for Reducing Ventilator-Associated Events in Mechanically Ventilated Patients](#).

Collect Outcome Measures

You can monitor the NHSN VAE surveillance data as an outcome measure.

The new VAE definitions replaced the old pneumonia definitions for NHSN reporting in January 2013.¹⁰ In 2012, physicians from the CDC, together with representatives of national critical care, infection prevention, and respiratory therapy societies were tasked to develop a new surveillance definition for VAP. This was in response to increasing concerns that the old pneumonia definitions were very subjective, and not sensitive nor specific. These limitations in the definition made benchmarking and measuring the effectiveness of a quality improvement difficult.¹¹

The new surveillance definitions use objective data, such as ventilator settings, to determine increasing oxygen requirements. The new VAE definition has a tiered structure: VAC, infection-related ventilator-associated complication, and VAP. While a VAC can be determined by a specific change in oxygen requirements, each consecutive level requires more information to differentiate.³¹ In addition, all of the information required to determine a VAE may be available in electronic medical records and/or other patient databases.

We also suggest that you collect outcomes data on monthly basis. This information provides another way to track your progress in changing patient outcomes. These outcomes include—

- Total number of patients on mechanical ventilation in your unit per month
- Total number of episodes of mechanical ventilation in your unit per month
- Total number of ventilator days in your unit per month
- Total number of hospital days for patients who were mechanically ventilated and housed in your unit at some time during their hospital stay per month (patients are counted in the month of discharge, regardless of which unit they are discharged from)
- Total number of deaths for patients who were mechanically ventilated and housed in your unit at some time during their hospital stay per month (patients are counted in the month of their death, regardless of their location at the time of death)

Phase 4. Ensure All Patients Receive the Intervention

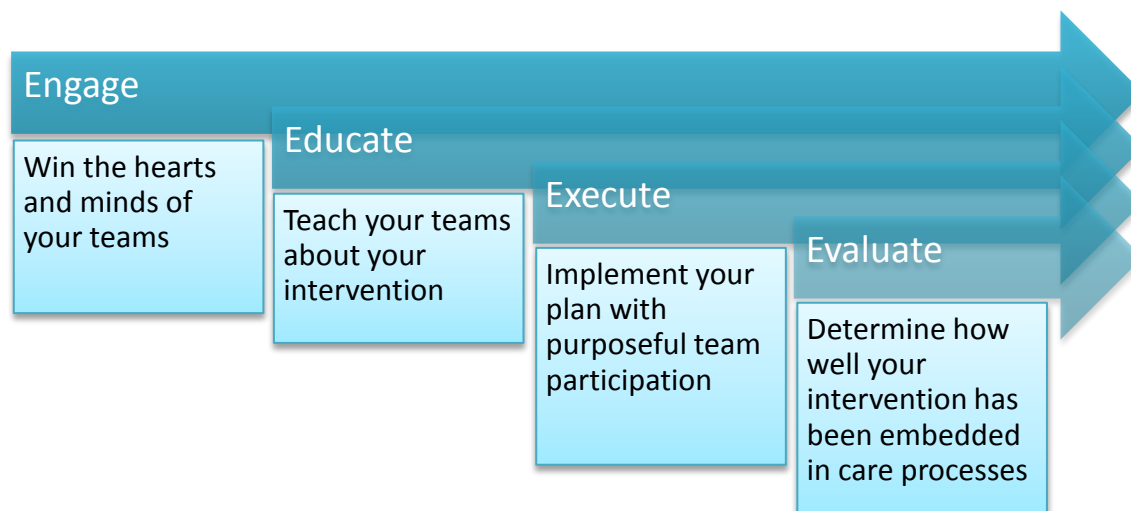
Finally, reliably deliver evidence-based care to 100 percent of your patients every day. Ensure that evidence-based interventions are embedded in the daily processes and become “the way things are done around here.” This phase poses the biggest challenge. While your improvement

team implements phases one through three of the TRIP model, phase four requires buy-in and involves your unit’s entire care team and the providers who care for patients.

The Four Es

Drawing from the published literature and experience, clinicians at the Johns Hopkins Hospital developed the Four Es implementation model. The model prompts your team to consider staff engagement, local culture, and contextual factors in a phased plan to embed your intervention in existing care processes. As shown in Figure 3, the Four Es represent the four phases of this expansion model.

Figure 2. Four Es Model



Operationalize the Four Es

Safety efforts succeed through the investment of key stakeholders, including senior leaders, improvement team leaders, and frontline staff. Though stakeholders have different perspectives, hopes, and fears, they often have the same questions about their involvement in the quality improvement process.^{20,23}

Put the Four Es model to work by explicitly addressing the questions that your key stakeholders are sure to have:

1. **Engage:** How will early mobility improve patient outcomes?
2. **Educate:** What do we need to mobilize critically ill patients?
3. **Execute:** How will we implement early mobility given local culture and resources?
4. **Evaluate:** How will we know that mobilizing our patients made a difference?

Engage: How Will Reducing VAEs Make the World a Better Place?

The number of quality improvement initiatives going on at your hospital can overwhelm your frontline staff. You may need to convince them that improving the care of mechanically ventilated patients and VAE prevention are not just the flavor of the month. You may need to convince them that mechanical ventilation is associated with significant preventable morbidity, mortality, and costs,²⁻⁵ and that incorporating these daily care interventions will improve long-term patient outcomes. Successful implementation of this program to improve care for mechanically ventilated patients is predicated on a change in both ICU culture and practice.

Methods that have proved useful include recruiting project champions to meet with and educate stakeholders from various ICU disciplines, thereby building support and addressing anticipated barriers. Sharing patient anecdotes, of both success stories and struggles recovering from critical illness, are an especially powerful way to engage clinicians. Also, inviting guest speakers with expertise in specific aspects of the program, such as delirium assessment and control, or handling patient sedation levels, or supporting attendance at lectures and related conferences, can help close the knowledge and training gap.^{2,13}



Daily Care Processes in Practice

“Our ICU nurses were very concerned about the new sedation protocol targeting light sedation and incorporating daily sedation interruptions. Specifically, they worried about the anticipated additional workload created by the new plan, as well as the safety and comfort of patients. Our nurse educator held many educational sessions with small groups of nurses to discuss their concerns. Later during nurse staff meetings, she engaged the nurses by (a) addressing their concerns with literature demonstrating the safety and effectiveness of minimizing sedatives, and (b) presenting the complications of sedation that patients suffered in our unit. She told stories about patients that had been harmed from prolonged sedation and discussed how delirium negatively impacted their recovery. She asked others to share stories, including a former patient. Putting a name and face to the significant complications went a long way to engage our nursing staff to minimize sedative use. They take great pride in their patient care.”

—Safety Program Unit Champion

Engage Senior Executives

In addition, designate a senior executive to advocate for resources and address barriers, whether global, discipline based, or patient-centric. This executive will attend regular interdisciplinary meetings, help prioritize that all eligible patients receive the best care in a timely manner, and employ organizational support and resources on behalf of your mechanically ventilated patients. You can garner executive support by stressing the positive impacts of this program: decreased duration of ventilation, decreased ICU length of stay, and decreased hospital length of stay. Executives on CUSP teams often find the connection with the frontline staff the most rewarding part of their role.

Make Performance More Visible

Quality improvement teams often share process and outcome performance measures with select individuals or improvement groups within their organization. Key stakeholders, including frontline staff and senior leadership, are often unaware of local performance. If you were to ask frontline staff and senior leadership what your VAE rates are, would they know the answer? In most cases, they likely would not.

Give your invested stakeholders feedback by sharing performance on process measures and VAE rates in these ways:

- Post a trend line of VAE rates in your intensive care units so nurses and physicians can see how VAE rates have changed over time.
- Post changes in the duration of mechanical ventilation, length of stay, and mortality.
- Post the number of weeks or months since your last VAE. Be sure to update it regularly.
- Share reports of the unit's compliance with process and policy measures with staff on the unit.
- Review VAE and process and policy measure compliance at key meetings

Make sure your staff recognizes that benchmarking your performance against similar hospitals and striving for the 50th percentile is unacceptable for preventable complications. Your goal should be that no patient suffers harm from a preventable complication while in your hospital. You can eliminate the harms associated with mechanical ventilation, such as VAE and delirium, and you can reduce length of stay and improve mortality rates.

Feedback will only be meaningful if your clinicians believe the data is valid. Be transparent about your data collection methods and any efforts made to address possible biases.

Recognize Staff Efforts

Financial incentives to engage staff and leaders, while attractive, are often not feasible or sustainable. Staff recognition using nonfinancial strategies often effectively engage your providers. Some examples include—

- Assign a title for key participants, such as the physician or nurse program leader.
- Encourage team members to present their efforts at important committee or board meetings within your organization.
- Highlight staff efforts in local newsletters, bulletins, or publications.
- Host events to gather similar teams across hospital system to share ideas.
- Present progress outside of your hospital system in publications and at conferences.

Educate: What Do We Need To Do To Reduce VAEs? What Is the Evidence?

Many health care providers are not aware that the interventions outlined in this guide can dramatically improve patient outcomes. Some are aware of the interventions, but are unfamiliar with the evidence supporting their use.

Get Your Message to Frontline Staff

Your team will need to educate staff and leadership about the evidence, explain new processes, answer questions, and set performance goals to eliminate VAEs and improve outcomes such as reduced length of stay.^{28,32} Workshops, hands-on trainings, conferences, slide presentations, and interactive discussions are all effective tools to use for staff education; multiple teaching modalities can meet diverse learning styles.^{32,33} Local champions and topic experts should be responsible for staff education,^{26,27,34} which should include both multidisciplinary and specialty-specific educational programs.^{35,36} Sessions must be informative and relevant for the learner. These sessions engage staff by explaining why the new practices should be adopted and encourage the staff to adopt the new practices.^{27,33}

Additional resources, including fact sheets and literature reviews, are available in the [Daily Care Processes section](#) of the [Technical Bundles module](#), in the [Toolkit To Improve Safety for Mechanically Ventilated Patients](#).

Educate Physicians

While educational sessions should be interdisciplinary, physicians are likely more receptive to other physicians. The physician champion on your safety program team should reinforce physician education efforts. Several education strategies described in the literature focus on changing physician behavior, including—

- Provide physicians with educational information packets consisting of research literature evidence-based reviews, hospital specific data, and national guidelines.
- Introduce educational information at staff meetings or Grand Rounds.
- Utilize informal educational meetings and networks to disseminate information.
- Conduct educational outreach visits involving content experts, such as respiratory therapists, pharmacists, pulmonologists or other intensivists, or infection preventionists.

Execute: How Will We Reduce VAE Rates Given Local Culture and Resources?

Frame Your Intervention in the Science of Safety

Without a doubt, clinicians care deeply about their patients. Yet we are all fallible. No matter how hard we try to deliver the highest quality of care to our patients, we will forget to order an important medication, and we will make mistakes. Patient safety research has demonstrated consistently that blaming individual doctors or nurses will not prevent patient harm. Organization-level factors, functional work area-related factors, team-related factors, task-related factors, and patient-related factors all have a role in patient outcomes. We need to ensure our system is designed to deliver these evidence-based interventions for every patient every day.

Apply Principles of Safe System Design

Every system is designed to produce the results it delivers. If we want to achieve substantive and sustainable improvements in patient outcomes, we have to change the flawed systems in which clinicians work. We must redesign systems to produce wellness instead of harm. Other industries teach us that there are clear principles of safe system design:

- Standardize care
- Create independent checks
- Learn from defects

Standardize Care

Standardizing care and reducing complexity helps to establish new care processes as “normal behavior” for staff.²⁸ One way to incorporate standardization into patient care is to use daily multidisciplinary rounds. Daily rounds should follow a structured format: discuss the patient’s goals for that day and determine what resources and actions are necessary to achieve those goals. Any potential barriers and/or any safety issues should be identified.^{14,30,37,38} The reality is that providers want to do the right thing for their patients. However, the care of a patient on mechanical ventilation is complex, and it is often difficult to remember everything we should do in real time.

Create Independent Checks

Creating independent checks or redundancy involves developing unique and separate system checks for critical procedures. High-reliability industries use independent redundancies to monitor those procedures that are highest risk or most likely to cause harm if not done correctly or if not completed at all. We are just beginning to develop independent redundancies in health care. The combination of both education and redundancy significantly improves processes of care.³⁹ Engaging all caregivers can provide a powerful independent redundancy. Include respiratory, physical and occupational therapists, nurses, and pharmacists in the care choices that are made. Encourage and reward leadership from frontline providers.

Learn From Defects

Learning from defects drives patient safety and quality improvement efforts, while tapping into the wisdom of frontline providers. A defect is anything you don't want to happen again—an unsafe condition, a patient fall, a venous thromboembolism, a medication error, a surgical site infection, wrong-site surgery, missing equipment, nursing time spent away from the bedside. In other words, a defect is anything that might lead to preventable patient harm.

There are different approaches to addressing defects: first-order (also known as “the workaround”) and second-order problem solving. First-order problem solving reduces risk for one patient by solving immediate need quickly (i.e., borrowing supplies or equipment from another room or department). Second-order problem solving reduces risks for future systems by improving systems. It often requires analysis to uncover root causes of the defect (i.e., policy of stocking specific supplies in a particular cart or area). In order to learn from defects, we need a shift in perspective, an attitude that errors and near misses have something to teach us about how we can improve our systems.

Use Strategies for Daily Care Evaluation

The following sections provide several strategies for standardizing care, reducing complexity, and creating independent checks. But also talk to your frontline providers! They likely have many, many other suggestions for creating a safer system design to ensure patients receive needed interventions.

Here is a summary of strategies to standardize care, create independent checks, and learn from defects in implementing the VAE prevention bundle:

- Maintain elevation of the head of bed to at least 30 degrees
- Use SSD-ETTs for patients ventilated for more than 72 hours
- Use SAT and SBT protocols
- Use a validated sedation scale (RASS or SAS) daily
- Assess delirium daily, using the ICDSC, the CAM-ICU, or the Attention Screening Exam
- Improve your early ambulation program

Maintain Elevation of the Head of Bed at Least 30 Degrees

Several successful strategies have been published to improve compliance with head of bed elevation at least 30 degrees. These include using a bed with a specific attachment that will show the angle at a glance, using a handheld protractor, or using a determination of what mark on which bed can signify the correct angle for recline. Head of bed elevation compliance should be reported to unit staff on a regular basis. Another strategy is to involve everyone who cares for the patient, including family members, to ensure elevation is maintained at or above 30 degrees if not contraindicated.

Use of Subglottic Secretion Drainage Endotracheal Tubes for Patients Ventilated for More Than 72 Hours

Maintaining a well-stocked supply of SSD-ETTs enables providers to choose them when clinically appropriate. Replace standard endotracheal tubes with SSD-ETTs in code carts for emergency intubation and in the ICUs for all reintubations. Anesthesiologists are asked to estimate if the patient under their care will remain intubated more than 72 hours, and to use SSD-ETTs in these patients. The use of SSD-ETTs has been shown to be exceedingly effective for VAE prevention,⁴⁰ and economic modeling suggests the use of these tubes actually reduces overall costs.⁴¹

Use of SAT and SBT Protocols

The adoption of SATs and SBTs is paramount to reducing the duration of mechanical ventilation and the risk of VAP. Girard et al. showed that pairing an SAT with an SBT reduces the duration of ventilation by 3.1 days and demonstrated a mortality benefit at 1 year post enrollment of 14 percent for patients receiving the paired intervention (NNT=7.4).⁴² SATs and SBTs are much easier to institute if they are considered the standard of care. Some sites have added SAT and SBT to a standard order set for patients on mechanical ventilation. Other sites have instituted a standard nursing led protocol for SAT and, if the patient passes the SAT, a respiratory therapy-led SBT, and some have incorporated SAT and SBT reminders into computer decision support systems.

Use a Validated Sedation Scale Daily

The routine use of validated scales allows providers to more precisely titrate sedatives. Use of these scales also results in less sedative use and less-sedated patients.⁴³⁻⁵ Targeting light sedation will help your patients remain alert and cooperative to the extent that they may be extubated earlier and/or participate in the mobility program. Light sedation also supports communication of needs and an accurate description of pain and pain control. Strategies for implementation can include incorporating discussions of sedation level in daily rounds. Set a target level and make sure staff members understand what needs to happen to help the patient reach the targeted level. Review the patient's progress during subsequent rounds or during huddles later in the day. Review the patient's sedation level as part of the SAT process.

Assess Delirium Daily, Using a Validated Scale

Routinely assessing the patient's cognitive function with validated scales will help you target lighter sedation levels and treat delirium. While delirium is not a contraindication to mobility efforts, treating delirium may assist in achieving the mobilization of your patients. The assessment of delirium can take place while performing the SAT. Degree of sedation should also be considered when assessing delirium, as rapidly reversible, sedation-related delirium does not signify the same poor prognosis as persistent delirium.⁴⁶ This assessment can also take place during or immediately prior to daily rounds to incorporate with evaluation of the patient.

The Society of Critical Care Medicine's 2013 Clinical Practice Guidelines for the Management of Pain, Agitation, and Delirium recommend the CAM-ICU or the [ICDSC](#) as the most valid and reliable delirium screening tools, and that moderate to high risk patients be screened at least once per nursing shift.^{47,48} This guide was developed using the CAM-ICU, but the ICDSC would

be a reasonable alternative. If this is not feasible, we recommend that patients at least undergo the ASE once daily.

The ASE is feature 2 of the CAM-ICU, assessing attention. Inattention is the cardinal feature of a delirium diagnosis and must be present to diagnose delirium. The goal of this 10- to 20-second test is to determine if a patient can follow a simple command (pay attention) for that period of time. For centers not using a full validated delirium screening tool, conducting the ASE can be a useful and rapid tool to suggest the presence or absence of delirium. This tool is useful as you begin to incorporate delirium assessment into your care delivery. This test may yield abnormal results due to disease, drugs or other causes.

Improve Your Early Ambulation Program

Get your patients up and out of bed. Reducing sedation levels can help you mobilize your patients earlier, leading to less cognitive impairment, reducing the number of readmissions, and increasing the patient's perception of well-being.⁴⁹⁻⁵³ Implementation of the SAT and SBT trials and the delirium and sedation assessments can help you determine whether a patient is ready to participate. In addition, early mobility itself may lower the rate and duration of delirium.⁵² Remember, there are many levels to mobility, from sitting and dangling to walking down the hall. Have your patients assessed for mobility level and set a target level for mobility each day. Involve a multidisciplinary team in your process as needed. The higher mobility levels may require active participation of nurses, respiratory therapists, and physical or occupational therapists.



Daily Care Processes in Practice

“There was a lot of excitement and interest among our ICU physicians, nurses, and administrators to implement an early mobility program. Few if any of our mechanically ventilated patients were being mobilized on a daily basis. Our hospital administration recognized the importance of mobilization and was prepared to invest the necessary resources to build a program.

But it was clear to our CUSP team that before we invested resources in additional rehabilitation provider support, equipment and nurse-led mobilization training, first our patients needed to be alert enough to participate in mobilization. This required changing our culture of sedation by targeting a lighter sedation level for all patients. Light sedation targets required provider education, standard sedation practices with a revised sedation protocol, and structured sedation and delirium assessments. Even with executive engagement and support, it took approximately 3 months for us to change the sedation practices before we could establish an early mobilization program.”

–Safety Program Physician Champion

Check Current Policies

Protocol and policies can be an effective strategy to improve adherence with evidence-based practice. We encourage you to review your existing policies and modify or implement new policies as needed to promote adherence with VAE prevention interventions in your ICU. For instance, consider the following opportunities to align the following policies with your VAE prevention efforts:

- Ensure availability of noninvasive ventilation equipment and standardize practices
- Prevent colonization of the aerodigestive tract
- Prevent aspiration
- Review multidisciplinary policy-related strategies

Ensure Availability of Noninvasive Ventilation Equipment and Standardize Practices

A noninvasive ventilation equipment policy standardizes equipment practices and defines when, where, and under what conditions noninvasive ventilation equipment should be used. Equipment should be easily accessible to the providers working in the unit and should be kept in good working condition with the required supplies. Without ease of equipment access, a policy of standard use is not practical. As such, the availability of the equipment without a standard policy will likely not be effective.

Prevent Colonization of the Aerodigestive Tract

1. A policy to encourage the use of orotracheal intubation over nasotracheal whenever orotracheal intubation is not contraindicated.
2. A policy to encourage the use of closed ETT suctioning systems, combined with the removal of open systems from supplies.
3. A policy to discourage the scheduled changing of closed suctioning catheters. These should only be changed as needed.
4. A policy to avoid the use of prophylactic systemic antimicrobials. The use of prophylactic antimicrobials for VAP is inappropriate, and long-term use of antimicrobials is known to lead to antimicrobial resistance. There are situations where prophylaxis is warranted, but these are exceptions where there is the possibility of a contaminated wound (trauma, surgery, etc.) or prophylaxis due to another comorbidity such as an immunodeficiency.

Prevent Aspiration

1. A policy to keep patients in a semirecumbent position (at least 30 degrees) whenever possible, unless this position is contraindicated.
2. A policy to discourage the use of nonessential tracheal suctioning. Place reminders in care areas or electronic medical records to discourage orders for scheduled regular suctioning.

3. Policies to prevent gastric overdistention. Keep feedings to a minimum volume and decompress the abdomen. Feeding volume should be closely monitored and appropriately minimized to avoid gastric overdistention. If needed, the abdomen should be decompressed.
4. A policy to encourage the use of an early mobility protocol. Encouraging mobility may decrease the propensity to atelectasis and increase clearance of bronchopulmonary secretions. It has also been shown to reduce the length of ventilation.⁴⁹⁻⁵³

Review Multidisciplinary Policy-Related Strategies

Several of these policy-related strategies require a multidisciplinary team. These teams can comprise nurses, respiratory therapists, and physical or occupational therapists, as needed.

1. Promote the use of standard precautions while suctioning respiratory secretions. This is very important for both the protection of the health care provider and for their patients. If the patient does have an infection or is colonized with a communicable organism, standard precautions can protect the health care provider and their subsequent patients.
2. Closed suctioning catheters should only be changed as needed. This can help prevent the patient from colonization of the lower respiratory tract, which might lead to infection. Change only when needed to minimize this risk.
3. Ventilator circuit should be drained periodically to protect the patient from inadvertent contamination. Caregiver should take care not to allow the condensate to drain toward the patient during procedure.
4. Ventilator circuits should only be changed if damaged or soiled.
5. Heat moisture exchangers should be changed every 5–7 days and as clinically indicated.
6. Help patients achieve the highest level of mobility possible on every day.

Overcome Challenges and Improving Patient Outcomes

Implementing these protocols, policies, and interventions might seem overwhelming, and it will take your leadership and dedication to make progress. Teams might find that a unified focus on reducing VAE rates, getting the patient off the ventilator faster, reducing the hospital and ICU length of stay, and reducing mortality makes the task easier. By approaching the task with patient-centered goals to reduce harm, teams can address policy changes in categories, such as equipment related changes, then medication changes.

As you start your process, prioritize interventions with a higher probability of success and a lower effort. This will help you celebrate your early progress and achieve momentum as you target more complex changes.

Improve Communication

One powerful strategy to improve communication and increase the likelihood that patients will receive evidence-based therapies is the [Daily Goals Checklist](#). It is completed each day on every

patient. Include SAT and SBT goals in rounds to remind providers to discuss results from the previous day's trials or how to proceed. The [Daily Goals Checklist](#) is also addressed in the [CUSP Guide for Reducing Ventilator-Associated Events in Mechanically Ventilated Patients](#). We encourage you to explore the use of the Daily Goals as part of this program to prevent VAEs.

Account for Local Culture and Resources

Don't force a square peg into a round hole. Adapt your intervention to the local culture and context. Intervention success is dependent on organizational culture. While your team needs to adapt to constraints and utilize opportunities, the [CUSP Guide for Reducing Ventilator-Associated Events in Mechanically Ventilated Patients](#), in the [Toolkit To Improve Safety for Mechanically Ventilated Patients](#), will help teams improve safety culture.

Evaluate: How Will We Know We Made A Difference?

The next step in the Four Es model is to evaluate the impact of your interventions. You need to assess whether your efforts are adding value for your staff, your patients, and their families.

Monitor Compliance With Evidence-Based Guidelines

It is important to monitor compliance with evidence-based interventions through frequent formal and informal audits. Share the audit results with all involved staff to maintain engagement and spur improvement. Through this monitoring process, you will be able to maintain awareness, establish expectations, create urgency, generate accountability, and reward changes in behavior. Evaluating performance provides an ongoing, real-time ground truth image of performance and outcomes. Areas of poor compliance can be identified and rectified. Any lingering compliance concerns are immediately recognized, allowing the improvement team to revisit. Walk the process with staff to gain additional insights into barriers to implementation and weak compliance rates. Celebrate your successes!

Collect and Monitor Data

To collect data and audit compliance, the [Daily Care Processes Data Collection Tool](#) lists mechanically ventilated patient care activities that should happen each day to minimize the patient's risk of harms and to maximize mobility including the following:

- Elevate head of the bed
- Use SSD-ETT if the patient is expected to be intubated for more than 72 hours
- Target a sedation level and perform a structured assessment of sedation level using a validated sedation scale
- Perform a structured assessment of delirium
- Minimize sedative use with the use of an SAT
- Link SAT and SBT to facilitate the discontinuation of mechanical ventilation
- Evaluate readiness for discontinuation of mechanical ventilation with daily SBT

<i>Tools</i>	<i>How To Use Them</i>
<u>Daily Care Processes Data Collection Tool</u>	This tool helps track the compliance with each of the recommended daily care measures shown to reduce the harms associated with mechanical ventilation.

Monitor Outcome Measures

Follow and share with your frontline staff current VAE rates, as well as changes in duration of mechanical ventilation, ICU and hospital length of stay, and mortality. Sharing outcomes will help energize your team to improve their performance. They can connect their care to differences in their patient outcomes, take ownership of compliance rates, and raise awareness of evidence-based practices. It also provides an opportunity to celebrate improvements and reflect on current practices.

Collect baseline VAE rates, ICU and hospital lengths of stay, and mortality for the mechanically ventilated patients in your unit. Duration of mechanical ventilation, ICU and hospital lengths of stay, and mortality can be pulled from administrative databases in most institutions.



Daily Care Processes in Practice

“Our facility dedicated a registered nurse to quality improvement. Each day she audits the charts for specific missed care requirements. When discrepancies from evidence-based care surface, she sets up hands-on education with those staff members. She adjusts her schedule to better support either the procedure or staff involved. Awareness of protocol and expectations is clarified and the nurse manager appreciates the data. We added the elements of the Daily Care Processes Tool to her list of care requirements as this project started.”

–Safety Program Nurse Champion

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