

Actionable Patient Safety Solutions™ (APSS™): Ventilator-Associated Pneumonia (VAP)

How to use this guide

This APSS provides evidence-based actions and resources for executives, leaders, clinicians, and performance improvement specialists. This document is intended to be used as a guide for healthcare organizations to examine their own workflows, identify practice gaps, and implement improvements. In it, you'll find:

Best Practice Summary: A high level summary of evidence-based, clinical best practices. (page 2)

Executive Summary: Executives should understand the breadth of the problem and its clinical and financial implications. (page 2)

Leadership Checklist: This section is for senior leaders to understand common patient safety problems and their implications related to Ventilator-Associated Pneumonia (VAP). Most preventable medical harm occurs due to system defects rather than individual mistakes. Leaders can use this checklist to assess whether best practices are being followed and whether action is needed in their organization around VAP. (page 3)

Clinical Workflow: This section includes more specific information about VAP across the continuum of care. Leaders should include the people doing the work in improving the work. This section outlines what should be happening on the frontline. Clinicians can use this section to inform leaders whether there are gaps and variations in current processes. This is presented as an infographic that can be used for display in a clinical area. (page 4)

Education for Patients and Family Members: This section outlines what frontline healthcare professionals should be teaching patients and family members about VAP. Clinicians can inform leaders whether there are gaps and variations in the current educational processes. (page 6)

Performance Improvement Plan: If it has been determined that there are gaps in current practice, this section can be used by organizational teams to guide them through an improvement project. (page 7)

What We Know About VAP: This section provides additional detailed information about VAP. (page 10)

Resources: This section includes helpful links to free resources from other groups working to improve patient safety. (page 11)

Endnotes: This section includes the conflict of interest statement, workgroup member list, and references. (page 12)

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Best Practice Summary

Routine Care

- Ensure that routine oral care is performed per hospital policy in order prevent build up of bacteria.
- Minimize ventilator exposure.
- Wean patients from the ventilator as early as possible.
- Ensure proper sedation levels for the patient by routinely assessing the patient's cognitive function.
- Leverage subglottic suctioning tools.
- Maintain effective hydration and nutrition.
- Ensure that the bed is kept at a proper angle between 30 degrees and 45 degrees as much as possible.
- Throughout time of care, diligently monitor the patient for the following:
 - Positive bacterial cultures
 - Temperature chart/log
 - Pharmacy reports of antimicrobial use
 - Any changes in respiratory secretions.

Discharge

- Ensure that the primary care physician is informed of VAP diagnosis and treatments while in the hospital, as well as any future concerns for the patient.
- Provide patients with information and supplies necessary for their continued care.
- For long term care facility patients, ensure that the receiving facility is prepared to care for the patient and is equipped with the necessary tools and equipment for the patient.
- Communicate to patients, family members, and receiving professional the patient's risk for VAP.

Executive Summary

The Problem

Ventilator-Associated Pneumonia (VAP) is the leading cause of death associated with healthcare-associated infections (HAIs) ([IHI, 2012](#)). With 300,000 cases of VAP annually in the U.S., this preventable illness is estimated to cost \$50,000 per patient ([Fraser et al., 2008](#)). In addition to being the second most common nosocomial infection worldwide, VAP is the most life threatening ([Timsit et al., 2017](#)). Prevention of VAP is inexpensive and could save up to \$15 billion per year. The diagnosis of VAP is challenging, as the available tools are inadequate to make an assessment of bacterial-induced lung injury ([Goel et al., 2016](#)).

The Cost

VAP mortality ranges between 20% and 60%, with an annual incidence of 4% to 48% ([Cook, 1998](#); [Heyland et al., 1999](#)). Patients who acquire VAP have a significantly longer and more complicated course of mechanical ventilation and a longer stay in the ICU ([Rello et al., 2002](#)). VAP cases account for 300,000 annual infections in U.S. hospitals, costing between \$10,000-\$40,000 per infection in the hospital with a mortality rate of between 19.4% to 53% ([Luckraz et](#)

[al., 2018](#); [Yun-Feng et al., 2019](#)).

The Solution

Many healthcare organizations have successfully implemented and sustained improvements that prevent complications and reduced death from VAP. This document provides a blueprint outlining the actionable steps organizations should take to successfully reduce VAP and summarizes the available evidence-based practice protocols. This document is revised annually and is always available free of charge on our website.

Leadership Checklist

On a monthly basis, or more frequently if a problem exists, the executive team should review the outcomes of patients who are placed on a ventilator for any duration of time (outside anesthesia). Use this checklist as a guide to determine whether current evidence-based guidelines are being followed in your organization:

Measure meaningfully.

- Acknowledge potential [challenges in diagnosing and reporting VAP incidence](#).
- Emphasize the measurement and reporting of compliance with VAP prevention best practices monthly. If a problem is not indicated, routinely reassess to identify gaps, and ensure integrity of the data collected.
- Make sure VAP performance and progress is easily visible to those doing the work:
- Post VAP longitudinal data in an easy to understand visual format.
- Ensure those on the frontline understand what intervention prompted the improvement (e.g., suctioning, minimized ventilator duration, etc).
- Share the amount of time since the last VAP incident.
- Review data reports at meetings and debriefs.
- Be transparent about data collection and possible biases.

Involve those doing the work in the improvement initiative.

- Ensure that VAP protocols are embedded into clinical workflows, whether electronic or paper. Assess compliance rate routinely.
- Ensure there are enough staff to effectively manage necessary preventive care. Assess which frontline professionals are completing VAP prevention practices and if this responsibility could be more appropriately allocated.
- Ensure adequate training and documentation of VAP prevention competencies and skills.
- Understand the barriers to implementation and/or sustainment, such as awareness of the evidence-based practices, buy-in to the practices, ability to implement the intervention easily in their existing workflow, etc.
- Provide a centralized place for care team planning and communication.
- Standardize practice across the system (e.g., patient positioning protocols should be the same across each facility).
- Ensure current policies align with protocols and workflows on the frontline. For example, standardize and align policies, protocols, and procedures around:
 - [Use of noninvasive ventilation equipment](#)

- Prevention of aspiration
- [Early mobility](#)
- Set up systems (e.g., interdisciplinary rounds) to minimize ventilator exposure.

Sustain the improvement.

- Hold staff accountable for providing the standard of care and reward success. Nonfinancial incentives may include:
 - Special titles for champions of the work.
 - Sharing an individual's or unit's efforts with a large group.
 - Highlighting efforts in an article or newsletter.
 - Presenting efforts, and calling out individuals or units by name, at conferences or events.
- Ensure that leaders have a simple process to oversee VAP improvement work while also considering how it aligns with other initiatives across the organization.

Clinical Workflow

1. ROUTINE CARE

- Perform routine oral care with frequency per hospital policy.
- Minimize ventilator exposure and wean from the ventilator as soon as possible. See [Ventilation Management](#) APSS.
- Routinely assess the patient's cognitive function twice a day to help in determining the best sedation levels when sedating. See [Moderate Sedation](#) APSS.
 - Conduct consistent weaning trials, daily sedation interruptions, and daily assessments of readiness to extubate.
- Maintain a stable, effective airway. See Airway Safety APSS.
 - Maintain ETT cuff pressure between 20-30cm H₂O. .
 - Rotate ETT to and re-secure every 72 hours.
 - Use a continuous or intermittent subglottic suctioning ([Seguin et al., 2018](#)).
 - Conduct chest X-ray daily.
 - Implement Unplanned Extubation standards. See [Unplanned Extubation](#) APSS.
 - Provide nebulizer therapy as indicated.
- Coordinate Peptic Ulcer Disease (PUD) prophylaxis.
- Maintain effective hydration and nutrition. Follow guidelines for [enteral nutrition in mechanically ventilated patients](#).
- Keep the bed angle between 30 degrees and 45 degrees.
- Use subglottic suctioning techniques with frequency per hospital policy.
- Tailor course of antibiotic to identified infectious agent and the length of time patient has spent on mechanical ventilator.
- Prevent exposure to contaminated equipment.

- Use organizational screening tools (e.g., [CPIS assessment](#)) to identify patients at risk for VAP.
- Monitor ventilated patients for:
 - Positive cultures (Examine invasive and non-invasive sampling.)
 - Temperature chart/log
 - Pharmacy reports of antimicrobial use
 - Change in respiratory secretions.
- Implement [early mobility management](#).



2. PLANNING FOR DISCHARGE TO HOME

- Share the VAP diagnosis, treatments, and any concerns with the primary care provider.
- Prepare patients with supplies necessary for their continued care (e.g., wheelchair accessibility, etc).
- Work with the person providing 24 hour care to ensure they are prepared to prevent VAP (e.g., trach care, emergency care, power outages, etc).
- Ensure patients and family members are equipped with the information and knowledge needed about their experience in the hospital. See "[Education for Patients and Family Members](#)" section for more information.



3. PLANNING FOR DISCHARGE TO LONG TERM CARE FACILITY

- Ensure the receiving facility is prepared to care for the patient (e.g., verify that the facility has the supplies needed for care).
- Communicate risks for aspiration, antibiotics, treatments, etc.

Education for Patients and Family Members

The outline below illustrates all of the information that should be conveyed to the patient and family member by someone on the care team in a consistent and understandable manner.

Share information relevant to the patient’s circumstance with patient and family members, which may include:

- Purpose of ventilator
- Risks of being on a ventilator
- What the team is doing to mitigate these risks, such as VAP
- What the family members can be doing to prevent VAP
- Information about common post-pneumonia symptoms
- Instructions on breathing exercises
- Methods to mitigate disrupted sleeping and eating patterns
- When to seek help if symptoms worsen ([Icahn School of Medicine](#))
- If oxygen therapy is needed at home and if so, how to complete
- If monitoring at home is needed and if so, how to complete
- If nebulizer therapy is needed at home and if so, how to complete
- Where/how to find help at home if needed
- Preventive measures for preventing VAP at home.

Adjust language and communication for patient and family member understanding. See [Healthcare Literacy](#) APSS.

HOW INFORMATION IS TYPICALLY CONVEYED TO PATIENTS	HOW TO IMPROVE
<p>“Weaning from a ventilator is a best practice to prevent VAP in ventilated patients.”</p>	<p>“Some patients require a ventilator to help them breathe but the more time a patient is on a ventilator, the more risk there is for ventilator-associated pneumonia, or “VAP”. VAP is an infection that is caused by being on a ventilator. So our main goal is to safely ‘wean’, or get patients off of the ventilator safely and as early as possible. This will help lower their risk for VAP. Other things can lower the risk for VAP too, such as...”</p>

Questions family members should ask

- “Are you going to raise the head of the bed while [patient] is on the ventilator?”
- “How are we going to prevent stomach ulcers?”
- “How long will [patient] be on a ventilator?”
- “What will you do to prevent blood clots?”
- “When can [patient] try breathing on their own?”
- “How often is this device cleaned?”
- “How often is [patient]’s mouth cleaned?”

Resources for families

- [Patient Education Material to Prevent Pneumonia Through Oral Care from the VHA](#)
- [What happens if you get pneumonia in the hospital?](#)
- [When someone you love is on a ventilator](#)
- [PatientAider® Airways and Ventilators section](#)
- [What You Need to Know About Ventilator-Associated Pneumonia \(VAP\), 2020](#)

Performance Improvement Plan

Follow this checklist if the leadership team has determined that a performance improvement project is necessary:

- Gather the right project team.** Be sure to involve the right people on the team. You'll want two teams: an oversight team that is broad in scope, has 10-15 members, and includes the executive sponsor to validate outcomes, remove barriers, and facilitate spread. The actual project team consists of 5-7 representatives who are most impacted by the process. Whether a discipline should be on the advisory team or the project team depends upon the needs of the organization. Patients and family members should be involved in all improvement projects, as there are many ways they can contribute to safer care.

Complete this Lean Improvement Activity:



Conduct a [SIPOC](#) analysis to understand the current state and scope of the problem. A SIPOC is a lean improvement tool that helps leaders to carefully consider everyone who may be touched by a process, and therefore, should have input on future process design.

RECOMMENDED VAP IMPROVEMENT TEAM

- | | |
|--|---|
| <ul style="list-style-type: none">• Respiratory care practitioners• Nurses• Physical and occupational therapists• Infection control specialists• Physicians• Pharmacists• Clinical educators• Dietary staff | <ul style="list-style-type: none">• Environmental service staff• Engineering staff• Information technology• Patient/family members• Data analysts• Reimbursement and coding personnel• IT/EHR specialists |
|--|---|

Table 1: Understanding the necessary disciplines for a ventilator-associated pneumonia project improvement team

- Understand what is currently happening and why.** Reviewing objective data and trends is a good place to start to understand the current state, and teams should spend a good amount of time analyzing data (and validating the sources), but the most important action here is to go to the point of care and observe. Even if team members work in the area daily, examining existing processes from every angle is generally an eye-opening experience. The team should ask questions of the frontline during the observations that allow them to understand each step in the process and identify the people, supplies, or other resources needed to improve patient outcomes.

Create a [process map](#) once the workflows are well understood that illustrates each step and the best practice gaps the team has identified ([IHI, 2015](#)). Brainstorm with the advisory team to understand why the gaps exist, using whichever [root cause analysis tool](#) your organization is accustomed to ([IHI, 2019](#)). Review the map with the advisory team and invite the frontline to validate accuracy.



VAP PROCESSES TO CONSIDER ASSESSING

Organizational Coordination

- Which groups receive reports/data of VAP prevention compliance, what is done with that data, how is the data analyzed, and with whom is it shared
- Which professionals are reporting to which bodies (e.g., Some within infection prevention will report to one governing body, while those in intensive care may report to another)
- Coordination of post-discharge needs (e.g., supplies needed at home, etc)

Respiratory Management

- Ventilator setting modification and monitoring
- Intubation decision making
- Weaning, sedation vacations, spontaneous awakening trials, and spontaneous breathing trials
 - Who is conducting, when, how often, what is their decision making process, how do they share information and work with other professionals
- Endotracheal cuff, subglottic suctioning, and tube maintenance

Prophylaxis

- Patient positioning
- Use of antibiotics and prophylactic systemic antimicrobials for VAP prevention ([Health Protection Surveillance Centre, 2011](#))
 - Who is prescribing and what are their justifications for prescribing
- [Antibiotic surveillance](#)

Table 2: Consider assessing these processes to understand where the barriers contributing to ventilator-associated pneumonia may be in your organization

- Prioritize the gaps to be addressed and develop an action plan.** Consider the cost effectiveness, time, potential outcomes, and realistic possibilities of each gap identified. Determine which are a priority for the organization to focus on. Be sure that the advisory team supports moving forward with the project plan so they can continue to remove barriers. Design an experiment to be trialed in one small area for a short period of time and create an action plan for implementation.

Be sure the plan includes the following:

- Assess the ability of the culture to change and adopt appropriate strategies
- Revise policies and procedures
- Redesign forms and electronic record pages
- Clarify patient and family education sources and content
- Create a plan for changing documentation forms and systems
- Develop the communication plan
- Design the education plan
- Clarify how and when people will be held accountable



TYPICAL GAPS IDENTIFIED IN VAP

- **Gap:** Clinicians do not follow evidence-based interventions.
 - Possible root causes:
 - ◊ Lack of awareness of the evidence-based interventions
 - ◊ Little agreement around the best intervention
 - ◊ Lack of convenient access to the equipment needed for the intervention
 - ◊ Poor care coordination and communication
 - ◊ Variations in adherence to the evidence-based intervention
 - ◊ Various levels of buy-in to the intervention

- **Gap:** There are variations in surveillance practices.
 - o Possible root causes:
 - ◊ Lack of standardization
 - ◊ Clinicians have different perceptions of best treatment (e.g., one clinician may aggressively wean, hand-off to a new clinician, and the new clinician may not agree with the aggressive weaning).
- **Gap:** Patients are excessively sedated.
 - o Possible root cause:
 - ◊ Not performing spontaneous awakening trials and spontaneous breathing trials.
 - ◊ Care is not well coordinated, orders are not being written based on evidence and patient assessment
- **Gap:** The VAP incidence rate is unknown.
 - o Possible root causes:
 - ◊ The definition of VAP versus VAE is poorly defined, which contributes to poor identification of the problem itself.
 - ◊ Vigilance and surveillance is not adequate ([Metersky et al., 2016](#))
- **Gap:** Organizations do not collect process indicators and instead focus on outcome metrics.
 - o Possible root causes:
 - ◊ Data is difficult to collect.
- **Gap:** Patient care is not coordinated between providers and across the system.
- **Gap:** The organizational bundle may not be comprehensive of all strategies to prevent VAP.
- **Gap:** Clinicians may not reliably incorporate VAP prevention strategies because these interventions are not easily incorporated into their existing workflow.
- **Gap:** The practices to prevent VAP overburden certain resources/personnel and may not leverage existing resources/personnel to their full capacity.
- **Gap:** Patients are oversedated.
- **Gap:** Patients are kept on the ventilator for too long.
- **Gap:** Patients are not mobilized as early as possible.
- **Gap:** Intubation protocols vary by practitioner.
- **Gap:** Oral care and subglottic suctioning practices often fall through the cracks.
- **Gap:** Handoff between shifts is poor and schedule details are not communicated well.
- **Gap:** The types of antibiotics prescribed are not appropriate for VAP.
- **Gap:** Patients without insurance may not have the resources for home health care.
- **Gap:** There is not a specific professional designated to evaluate needs for home care.

Table 3: By identifying the gaps in ventilator-associated pneumonia prevention compliance, organizations can tailor their project improvement efforts more effectively

- **Evaluate outcomes, celebrate wins, and adjust the plan when necessary.** Measure both process and outcome metrics. Outcome metrics include the rates outlined in the leadership checklist. Process metrics will depend upon the workflow you are trying to improve and are generally expressed in terms of compliance with workflow changes. Compare your outcomes against other related metrics your organization is tracking.

Routinely review all metrics and trends with both the advisory and project teams and discuss what is going well and what is not. Identify barriers to completion of action plans, and adjust the plan if necessary. Once you have the desired outcomes in the trial area, consider spreading to other areas ([IHI, 2006](#)).

It is important to be nimble and move quickly to keep team momentum going, and so that people can see the results of their labor. At the same time, don't move so quickly that you don't consider the larger, organizational ramifications of a change in your plan. Be sure to have a good understanding of the other, similar improvement projects that are taking place so that your efforts are not duplicated or inefficient.

VAP METRICS TO CONSIDER ASSESSING

- Antibiotic surveillance
- Total number of patients on a mechanical ventilator per unit per month
- Total number of episodes of mechanical ventilation per unit per month
- Total number of ventilator days per unit per month
- Hospital days
- Hand hygiene compliance
- Percent of patients achieving RASS/SAS target
- Percent of patient days mobilized out of bed
- Delirium assessment compliance rate
- Ventilator LOS
- ICU LOS

Table 4: Consider evaluating related metrics to better understand ventilator-associated pneumonia presence and contributing factors

What We Know About VAP

Mechanically-ventilated hospital patients are usually critically ill and need to be treated in an intensive care unit (ICU). The infections that develop after two days or more of mechanical ventilation are thought to be caused by pathogenic secretions entering the lower respiratory tract via the endotracheal tube or tracheostomy. Even when airways are properly maintained, intubation may allow for oral, nasal, and gastric secretions to enter the lower airway. VAP and pediatric ventilator associated pneumonia (PVAP in individuals aged 18 and younger) are among the most commonly occurring health-care setting acquired infections in the intensive care unit or ICU ([“Daily Care Processes”, 2017](#)).

Clinical Implications

VAP is the leading cause of death associated with healthcare-associated infections (HAIs) ([IHI, 2012](#)). However, between 2006-2012, there was a decrease from 3.1 to 0.9 of reported incidence of VAP in medical units ([Metersky et al., 2016](#)). The impetus for this decrease is debated, but still highlights the discrepancy between reported versus observed VAP rates. Patients who acquire VAP have significantly longer durations of mechanical ventilation and a longer stay in the ICU ([Rello et al., 2002](#)). According to the Agency for Healthcare Research and Quality, approximately 10 to 20 percent of patients suffering from VAP are twice as likely to die from being hospitalized ([“Daily Care Processes”, 2017](#)).

Financial Implications

Additionally, researchers predict that implementing system-wide change and the use of technology to reduce VAP can save up to \$15 billion per year while significantly improving quality and safety ([Scott, 2009](#)). For patients in the hospital that acquire VAP, the average extended stay for them in the hospital is 4 to 9 days ([“Daily Care Processes”, 2017](#)) which not only places more stress on our patients, but it also places stress on medical professionals and is costly for the hospital.

Challenges in VAP Diagnosis

In 2014, the National Healthcare Safety Network replaced VAP with the terms Ventilator-Associated Events (VAE), Ventilator-associated Conditions (VAC), and Infection-related (IVAC) in an attempt to address subjective diagnosis and unreliable reporting of VAP. At the time, it was hypothesized that changes in mechanical ventilation settings at the time of diagnosis would provide a sensitive measurement of the rates of pneumonia and remove clinical subjectivity from reporting. This hypothesis proved to be incorrect and VAE surveillance does not accurately detect cases of traditional VAP in ICUs (Fan, 2016). In 2016, a report in JAMA reported that while the reported rate of VAP had dropped significantly, the true incidence of VAP, in a large

survey of ICU patients, showed no significant change ([Metersky et al., 2016](#)).

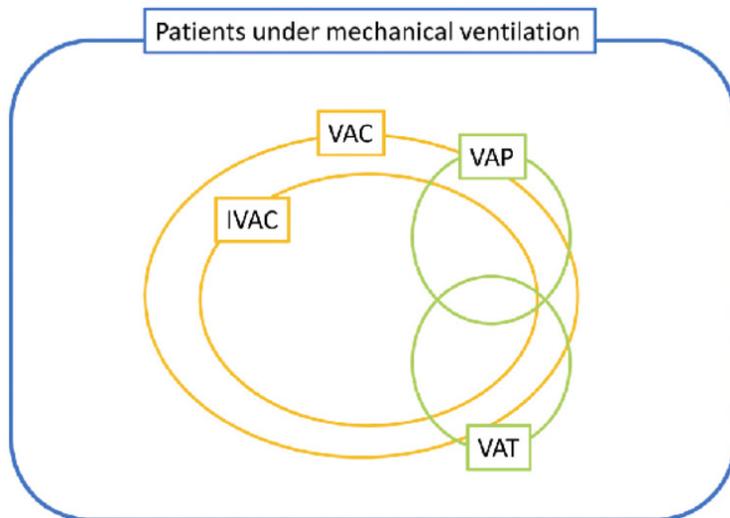
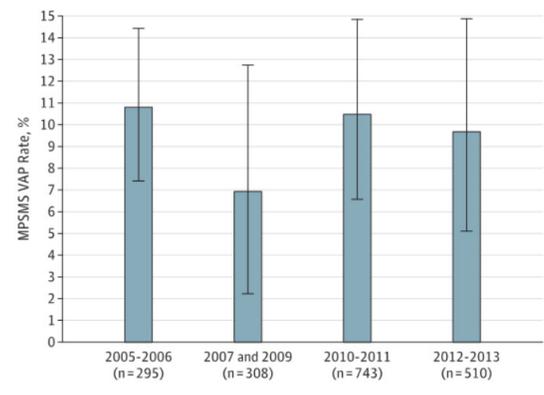


Figure. Adjusted Ventilator-Associated Pneumonia Rates Among Medicare Patient Safety Monitoring System Patients 65 Years and Older, 2005-2013, Based on Bootstrap Analysis



Error bars indicate 95% CIs.

In 2020, VAE surveillance has been suspended and the current state of VAP surveillance is perilous. In the absence of effective surveillance measures, individual healthcare organizations need to take steps to strengthen clinical vigilance, appropriate antibiotic use, and pneumonia prevention measures.

Resources

- [Suspected VAP Decision Making Pathway](#)
- [Guidelines for the Prevention of Ventilator-associated pneumonia in Ireland in adults](#)
- [Development and implementation of a performance improvement project in adult intensive care units: overview of the Improving Medicine Through Pathway Assessment of Critical Therapy in Hospital-Acquired Pneumonia \(IMPACT-HAP\) study](#)
- [Ventilator Bundle Checklist from IHI](#)
- [Daily Care Processes Guide for Reducing Ventilator-Associated Events in Mechanically Ventilated Patients](#)
- [CDC: Guidelines for Prevention of Nosocomial Pneumonia](#)
- [CMS: Ventilator-associated Pneumonia \(VAP\)](#)
- [SIPOC Example and Template](#)
- [CDC: Disinfection of healthcare equipment](#)
- [HQI: ICU Sedation Guidelines of Care toolkit](#)
- [AARC: Best practices for ventilator weaning protocols](#)
- [Summary of the international clinical guidelines for the management of hospital-acquired and ventilator-acquired pneumonia](#)
- [2021 Daily Care Processes](#)
- [Ventilator-Associated Pneumonia: Truths and Old Wives Tales](#)
- [AHRQ: Benefits of Subglottic Secretion Drainage Endotracheal Tubes: Facilitator Guide](#)



- [AHRQ: Safe Programs for Mechanically Ventilated Patients](#)
- [AHRQ: Getting Patients Off the Ventilator Faster](#)

For General Improvement:

- [CMS: Hospital Improvement Innovation Networks](#)
- [IHI: A Framework for the Spread of Innovation](#)
- [The Joint Commission: Leaders Facilitating Change Workshop](#)
- [IHI: Quality Improvement Essentials Toolkit](#)
- [SIPOC Example and Template for Download](#)
- [SIPOC Description and Example](#)

Endnotes

Conflicts of Interest Disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Workgroup members are required to disclose any potential conflicts of interest.

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