Actionable Patient Safety Solution (APSS) #2D:
VENTILATOR-ASSOCIATED PNEUMONIA (VAP)

Executive Summary Checklist

Pneumonia that is acquired while a patient is receiving mechanically-assisted ventilation (VAP) is a serious problem in critically-ill patients, resulting in many patient deaths each year.

☐ Commitment from hospital leadership to support a program to eliminate VAP.
☐ Implement evidence-based guidelines to prevent the occurrence of VAP.
  ● Prevent aspiration of secretions
    ○ Maintain elevation of head of bed (HOB) (30-45 degrees)
    ○ Avoid gastric over-distention
    ○ Avoid unplanned extubation and re-intubation
    ○ Use cuffed endotracheal tube with in-line or subglottic suctioning
    ○ Maintain the endotracheal tube cuff pressure at greater than 20 cmH2O
    ○ Encourage early mobilization of patients with physical/occupational therapy
    ○ Ensure that patient is conscious and responsive prior to extubation.
  ● Reduce duration of ventilation
    ○ Conduct “sedation vacations”
    ○ Assess readiness to wean from ventilator daily
    ○ Conduct spontaneous breathing trials
  ● Reduce colonization of aero-digestive tract
    ○ Use non-invasive ventilation methods when possible (i.e. CPAP, BiPap)
    ○ Use oro-tracheal over naso-tracheal intubation
    ○ Use cuffed Endotracheal Tube (ETT) with inline or subglottic suctioning
    ○ Perform regular oral care with an antiseptic agent
    ○ Reduce opportunities to introduce pathogens into the airway
  ● Prevent exposure to contaminated equipment
    ○ Use sterile water to rinse reusable respiratory equipment
    ○ Remove condensation from ventilator circuits
    ○ Change ventilator circuit only when malfunctioning or visibly soiled
    ○ Store and disinfect respiratory equipment effectively
  ● Measure adherence to VAP prevention practices and consider monitoring compliance
    ○ Hand Hygiene
    ○ Daily sedation vacation/interruption and assessment of readiness to wean
    ○ Regular antiseptic oral care
    ○ Semi-recumbent position of all eligible patients
  ● Monitor ventilated patients for: positive cultures, temperature chart/log, pharmacy reports of antimicrobial use, and change in respiratory secretions
    ○ When complications exist, raise them on top of the patient’s EHR problem list.

☐ Develop an education plan for attendings, residents and nurses to cover key curriculum pertaining to the prevention of VAP.
☐ Encourage continuous process improvement through the implementation of quality process measures and metrics and a monthly display through a dashboard.
The Performance Gap

Ventilator-associated pneumonia (VAP) is an infection that appears in the lungs when a patient is mechanically ventilated. Mechanically ventilated hospital patients are typically critically ill and treated in an intensive care unit (ICU). The infection develops after 48 hours or more of mechanical ventilation and is caused when bacteria reaches the lower respiratory tract via the endotracheal tube or tracheostomy; in addition, when airways are not properly maintained intubation may allow oral and gastric secretions to enter the lower airways (Amanullah, 2015).

VAP is the leading cause of death associated with healthcare-associated infections (HAIs) (IHI, 2012). In the US, a multi-state prevalence survey estimated the incidence of VAP in the US at 49,900 cases annually (Magill, 2014). As many as 28% of all patients who receive mechanical ventilation in the hospital will develop VAP and the incidence increases with the duration of mechanical ventilation. The crude mortality rate for VAP is between 20% and 60%; and incidence ranges from 4% to 48% (Cook, 1998, Heyland, 1999). Depending on the type of pneumonia the mortality rate may vary; Pseudomonas and Acinetobacter are associated with higher mortality rates than other strains of bacteria (Fagon, 1996). It is believed that when antibiotic therapy is delayed or improperly dosed, mortality also increases. These factors are largely preventable.

Patients who acquire VAP have significantly longer durations of mechanical ventilation, length of ICU stay as well as hospital stay (Rello, 2002). In addition, the development of VAP is associated with significant increase in hospital costs and poor economic outcomes. VAP is associated with greater than $40,000 in mean hospital charges per patient.

It is estimated that the use of process change and technology to reduce VAP can save up to $1.5 billion per year while significantly improving quality and safety (Scottm 2009). Closing the performance gap will require hospitals and healthcare systems to commit to action in the form of specific leadership, practice, and technology plans, examples of which are delineated below for utilization or reference. This is provided to assist hospitals in prioritizing their efforts at designing and implementing evidence-based bundles for VAP reduction.

Leadership Plan

- Hospital governance and senior administrative leadership must champion efforts in raising awareness to prevent and manage VAP infections safely.
- Healthcare leadership should support the design and implementation of an antimicrobial stewardship program.
- Senior leadership will need to integrate surveillance and metrics to ensure prevention measures are being followed.
- Leadership commitment and action are required at all levels for successful process improvement.

Practice Plan

Establish and consistently implement VAP prevention guidelines that focus on surveillance, minimization of ventilator patient days, prevention of aspiration and gastric distention, equipment cleansing, oral hygiene and avoidance of unintended extubation and reintubation (Coffin, 2008). An example of an evidence-based bundle is the Institute for Healthcare Improvement’s How-to Guide: Prevent Ventilator Associated Pneumonia. This Guide can be accessed online through the Institute for Healthcare Improvement (IHI). In addition the Armstrong Institute for Patient Safety and Quality at John Hopkins University has published a Toolkit to Improve Safety of Mechanically Ventilated Patients that includes recommendations on preventing, measuring and tracking outcomes related to VAP. This Toolkit can be accessed online through the John Hopkins Medicine website.
We have also listed the key components here:

- If tolerated by patient, elevate the Head of the Bed to between 30 and 45 degrees
- Daily Sedation Interruption and Daily Assessment of Readiness to Extubate
- Peptic Ulcer Disease (PUD) Prophylaxis
- Deep Venous Thrombosis (DVT) Prophylaxis
- Daily Oral Care with Chlorhexidine
- Check the patient’s ability to breathe on his/her own every day so the patient can be taken off the ventilator as soon as possible (CDC).
- Before and after touching the patient, ensure that healthcare providers are following hand hygiene procedures.

Technology Plan

Suggested practices and technologies are limited to those proven to show benefit or are the only known technologies with a particular capability. As other options may exist, please send information on any additional technologies, along with appropriate evidence, to info@patientsafetymovement.org

- Implement endotracheal tubes designed to drain subglottic secretions
  - Such as Kimberly-Clark® KIMVENT MICROCUFF Subglottic Suctioning Endotracheal Tube, Teleflex® ISIS HVT, Smiths Medical Portex SACETT Suction Above Cuff Endotracheal Tube or Mallinckrodt® SealGuard Evac Endotracheal Tube
- If endotracheal tubes designed to drain subglottic secretions are not available, consider use of the Vyaire Medical Tri-Flo Subglottic Suction System
- Implement oral hygiene including the use of Chlorhexidine
- Such as SAGE Q-Care Rx Oral Cleansing and Suctioning Systems or HALYARD or Medline Oral Care Kits with CHG
- Implement electronic surveillance technologies that support antimicrobial stewardship (in late onset cases of VAP bacteria is often multi-drug resistant, and can have great clinical and economic challenges)
- Considering implementation of Electronic Measurement of hand hygiene compliance. See APSS 2A for details.
Metrics

Topic:

**Ventilator-associated Pneumonia Rate (VAP)**
Rate of patients on a ventilator for more than 48 hours who develop pneumonia while on the ventilator or within 1 day of ventilator removal per 1,000 ventilator-days

Outcome Measure Formula:

Numerator: Ventilator-associated Pneumonia infections based on CDC NHSN definitions for all inpatient units (CDC, 2016).

Denominator: Total number of ventilator-days for all patients on a ventilator in all tracked units

*Rate is typically displayed as VAP/1000 ventilator days*

Metric Recommendations:

**Indirect Impact:**
All patients with conditions that lead to temporary or permanent ventilation

**Direct Impact:**
All patients that require invasive ventilation.

**Lives Spared Harm:**

\[ \text{Lives} = (\text{VAP Rate}_{\text{baseline}} \times \text{VAP Rate}_{\text{measurement}}) \times \text{Ventilator days}_{\text{baseline}} \]

**Notes:**
To meet the NHSN definitions, infections must be validated using the hospital acquired infection (HAI) standards (CDC, 2016). Infection rates can be stratified by unit types further defined by CDC (CDC, 2016). Infections that were present on admission (POA) are not considered HAI and not counted.

**Data Collection:**
VAP and ventilator-days can be collected through surveillance (collected at least once per month and reported monthly) or gathered through electronic documentation. Denominators documented electronically must match manual counts (+/- 5%) for a 3 month validation period.

**Mortality (will be calculated by the Patient Safety Movement Foundation):**
The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient’s grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. “At the outset of the PfP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PfP. In conjunction with CMS’s overall leadership of the PfP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the “AHRQ National Scorecard,” which provides summary data on the national HAC rate (AHRQ, 2015).
Workgroup

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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. Some of the APSS recommend technologies offered by companies involved in the Patient Safety Movement Foundation that the workgroups have concluded, based on available evidence, are beneficial in addressing the patient safety issues addressed in the APSS. Workgroup members are required to disclose any potential conflicts of interest.

References
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CUSB 4 MVP-VAP, Johns Hopkins Armstrong Institute.
Centers for Disease Control and Prevention. Frequently asked questions (FAQs) about "ventilator-associated pneumonia".
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