Actionable Patient Safety Solutions (APSS) #2G:

Non-ventilator Hospital-acquired Pneumonia

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for NV-HAP. In it, you'll find:

Patient Safety MOVEMENT

Executive summary checklist

Hospital-acquired pneumonia is the #1 hospital-acquired infection, with non-ventilator hospital-acquired pneumonia (NV-HAP) representing over 60% of cases (Magill et al., 2018). An estimated 35 million U.S. patients are at risk of contracting NV-HAP annually. (Baker & Quinn 2018, Magill et al., 2014). NV-HAP occurs in all types of hospitals and with all types of patients, even younger, healthier patients and maternity patients (Baker & Quinn, 2018). Therefore, hospital leadership should prioritize efforts to prevent NV-HAP and serious preventable harm and death in hospitalized patients in the United States.

What we know about NV-HAP

- One in every four hospital-acquired infection is pneumonia, the majority (60%) are non-ventilator hospital-acquired pneumonia (NV-HAP) (Magill et al 2018)
- Associated mortality from NV-HAP ranges from 15 to 30%, far exceeding other hospital-acquired infections' mortality rates (Davis & Finley, 2012; Micek, Chew, Hampton, & Kollef, 2016; Quinn, et al., 2014; Baker & Quinn, 2018; Giuliano, Baker, & Quinn, 2018).
- Patients who develop NV-HAP are over 8 times more likely to die than their equally matched controls who do not develop NV-HAP (Micek et at., 2016)
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- Pneumonia risk can be minimized through preventive measures. (Baker et al. 2019)
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- Patients who develop NV-HAP require longer hospital care days often including intensive care. The average length of stay is up to 4 times longer than patients without NV-HAP (Micek et al. 2016; Thompson, Makary, Dorman, & Pronovost, 2006).
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- The patient who acquires NV-HAP may require mechanical ventilation and large amounts of broad-spectrum antibiotics. Serious side effects of antibiotics including clostridium difficile and antibiotic resistance may occur.
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- Younger patients (<65 years of age) constitute half of all hospital-acquired pneumonia cases, most of which originate outside of the ICU. Hospital-acquired pneumonia has long been associated with the elderly and intensive care units (ICU). But according to a new multicenter nationwide study, NV-HAP occurs across all units in all types of sizes of U.S. hospitals, putting every patient, the young included, at higher risk for developing the infection. (Baker & Quinn, 2018).
- Pneumonia risk can be minimized through preventive measures. Researchers found basic pneumonia prevention measures were not consistently followed; 58.6 percent of patients diagnosed with NV-HAP did not receive oral care; 81.8 percent did not receive incentive spirometry; 67.4 percent did not undergo cough and deep breathing exercises and only 28.7 percent of patients ambulate at least twice in the 24-hours prior to their pneumonia diagnosis. (Baker & Quinn, 2018).

Background and Significance

- Over the past decade, hospital-based quality improvement initiatives have been focused primarily on the prevention of ventilator-associated pneumonia (VAP), resulting in significant decreases in reported cases of VAP (DiBiase et al., 2014). With the reduction in VAP, NV-HAP now has a larger overall impact on patient morbidity, mortality, and cost of care than VAP (Davis and Finley, 2012; Micek, Chew, Hampton, and Kollef, 2016; Giuliano, Baker and Quinn, 2018).In a point-prevalence study conducted by the Center for Disease Control and Prevention in 2014, HAP (NV-HAP 62% of total HAP) was tied with surgical site infections as the leading cause of hospital-acquired infections (Magill et al., 2014).

Current data published by the CDC in 2018 now supports HAP as the leading hospital-acquired infection (HAI), with NV-HAP representing at least 60% of the cases (Magill et al., 2018)Review of 2012 data from Pennsylvania Safety Authority supported that NV-HAP occurs on all types of

hospital units and had a higher impact on both cost and mortality than VAP (Davis and Finley, 2012). This study was replicated in 2018 with similar findings (Davis and Finley, 2018). The CDC and Pennsylvania studies demonstrate that patient harm from NV-HAP has persisted over time and that little has been done to reduce the incidence.

Analysis of the 2012 National Inpatient Sample dataset demonstrates a NV-HAP incidence of 16 %, a rate of 3.63 per 1,000 patient days, associated mortality of 13.1%, and an actual hospital cost of care of $39,897 (Giuliano, Baker, and Quinn, 2018). When matched with equally sick controls, NV-HAP had an associated mortality of 15.5% vs. 1.6% in the matched cases (Micek, Chew, Hampton, and Kollef, 2016).An international review of the literature found that most HAP occurs outside of the ICU, and requires monitoring and protocols that vary from standard VAP prevention (Di Pasquale et al., 2016). An associated mortality rate of 30% among NV-HAP patients was found by See and colleagues (2016), far exceeding the associated mortality from other iatrogenic harm.

A review of hospitals in Spain found a 28% NV-HAP mortality rate (Sopena et al., 2014). In patients with spinal injury, Kopp found that 47% suffered consequences of NV-HAP and were more likely to die, even 10 years after hospitalization (Kopp et al., 2017). Finally, researchers studying NV-HAP in 21 US hospitals found rates of 0.12-2.28 per 1,000 patient days (1,300 NV-HAP patients). Most NV-HAP infections (70.8%) were acquired outside of the ICU and 18.8% required an unplanned transfer into the ICU (Baker and Quinn, 2018). NV-HAP is a leading cause of healthcare acquired infection in the US, which the CDC already recognized as a top 10 public health concern. Michael Klompas, a leading pneumonia researcher, refers to NV-HAP as the "next frontier in patient safety" (Klompas, 2016).

Etiology of NV-HAP

Pneumonia occurs when bacteria move from proximal sites, such as the oral microbiota, into the lung and incite an inflammatory response (Gomes-Filho, Passos, Seixas da Cruz, 2010; Scannapieco, 2013; Scannapieco and Shay, 2014). Researchers have found a critical relationship between oral microflora and HAP (Di Pasquale et al., 2016; Sopena et al., 2014; Scannapieco and Shay, 2014). While HAP can be associated with multiple types of organisms, it is primarily caused by bacteria and viral organisms (Micek, et al., 2016). For example, bacteria found in patients with HAP have been matched with specific flora found in the oral cavity (Gleeson, Maxwell, and Eggli, 1997; Huxley, Viroslav, Gray, and Pierce, 1978; Didilescu, Skaug, Marica, Didilescu, 2005).

During the first 48 hours of hospitalization, especially in the absence of regular oral care, changes occur in an individual's oral microbiota that are associated with more virulent pneumonia-causing organisms (Abele-Horn, et al., 1997). Respiratory pathogens such as S aureus, P aeruginosa, Klebsiella pneumoniae, and Enterobacter cloacae colonize the dental plaque and micro-aspirations contribute to inoculation of virulent organisms into the lungs, even in healthy adults (Gleeson, et al., 1997; Huxley, et al., 1978; Didilescu, et al., 2005) Recognition of this relationship between the oral microbiota and HAP has led to a growing evidence which targets primary source control of HAP through removal of the oral biofilm.

Prevention Quality Improvement Projects

Prevention of NV-HAP is a patient safety concern that workgroups have been working on for several years. Provided here are some representative examples of Hospital-acquired pneumonia prevention initiative (HAPPI) successes. In many cases, this success has been led by nurses with integral involvement of the interdisciplinary team (infection prevention, nursing

assistants, respiratory therapists, speech-language therapists, physicians, nursing and hospital management, informatics, and supply chain).

Sutter Health System

Specialists at Sutter Health launched a study to explore an oral care intervention that would help prevent hospital-acquired pneumonia. Under the leadership of Barbara Quinn CNS, RN, Director of Professional Excellence and Nursing Practice for Sutter Health System, a hospital pneumonia prevention effort was launched. The focus was on oral biofilm removal through oral care.

Compared to a 2010-2011 baseline, hospital-acquired pneumonia cases declined by 70% from May 2012 through December 2014 (Baker et al. 2019). Results sustained over a 4-year period saved lives and millions in healthcare expenditures (Quinn et al., 2014; Baker & Quinn, 2018).

Statistical process control R and X-bar-charts demonstrate a significant improvement in the number of NV-HAP following each of the intervention periods. Control limits were calculated from the baseline data. Data starting in July 2013 indicates special cause with all the subsequent points below that mean (15.89). The control chart demonstrates 4 operating modes with each phase operating below the baseline mean . Oral care improved from .25 per day to 2.89 times per day (Figure : Statistical process control R and X-bar-charts: International Statistical Classification of Diseases and Related Health Problems (ICD) codes (3 standard deviations).

More information can be found in the reference page below (Baker, Quinn, Ewan, & Giuliano, 2018; Baker & Quinn, 2018; Lagnado, 2018; Quinn & Baker, 2015; Quinn, Baker, Cohen, Stewart, Lima, & Parise, 2014).

The United State's largest integrated health care system, the Veterans Health Administration (VHA)

The VHA, manages the care of over 8 million Veterans across 153 medical centers. A team at the Salem VA Medical Center (VAMC) led by Shannon Munro, PhD, NP partnered with the HAPPI research team, examined over 12 years of retrospective and prospective data, and found that an oral care regimen significantly reduces the risk of developing NV-HAP, thus shortening hospital stays, reducing direct health care costs, lowering the need for a higher level of care (e.g. intensive care and discharge to long term care), and saving lives.

At the first VA pilot site, the community living center (CLC) units at Salem VAMC, the incidence rate of NV-HAP decreased from 105 cases to 8.3 cases per 1,000 patient days (decreased NV-HAP by 92%) in the first year, yielding an estimated cost avoidance of $1.76 million and 8 lives saved.

The population of the CLC units is primarily composed of elderly Veterans with complicated chronic health problems requiring rehabilitation and long-term care. Veterans on the CLC units were 10.7 times less likely to develop NV-HAP with consistent oral care than patients receiving standard nursing care. The Houston VAMC replicated the practice in 2017 and reduced the rate of NV-HAP in the coronary care unit and step-down unit (165 admissions per month) from 11 cases to 0 cases per 1,000 patient days and saved an estimated hospital cost of $480,000 and two patient lives in six months.

These successful outcomes at the original VA pilot sites led to funding from the VHA Diffusion of Excellence Initiative, VHA Quality Enhancement Research Initiative (QUERI), VHA Office of Strategic Integration, and the Veterans Engineering Resource center to support continued expansion efforts as quality improvement. Across all reporting units in 8 VA hospitals in Virginia,

North Carolina, and Texas, a predicted 255 cases were avoided as of July 31, 2019. Should we extrapolate the data, there is a cost avoidance estimate of $10.1M and 46 Veteran lives saved. Nationwide VA deployment is underway in 41 VA hospitals including 122 medical-surgical, ICU, CLC, and mental health units.

The VA established a national Hospital-acquired Pneumonia Prevention by Engaging Nurses(HAPPEN) program and VHA oral care implementation toolkit under the leadership of Dr. Munro.The HAPPEN toolkit is freely available for download.

Implementing the inpatient oral care practice ensures all hospitalized Veterans receive oral care by:

- VHA's patient education materials
- CVS Informational Toolkits:
- Aetna's Informational Toolkits

Sparrow Hospital (Lansing, Michigan)

With two rounds of grant funding from Delta Dental of Michigan, Sparrow Hospitals developed a nurse-driven oral care protocol (NDOCP) using HAPPI protocol. Variables included age, hospital length of stay, white blood cell count at pneumonia diagnosis, admission type, sex, mortality and presence of confusion for patients with NV-HAP in both the pre and intervention groups, along with compliance to the NDOCP and the incidence NV-HAP.

There were significantly more NV-HAP cases pre-NDOCP than post-NDOCP (95% CI $p < .05$; pre-52 versus post-26, $X2=12.8[df=1]$, $p=.0004$). NV-HAP rates were 2.84 per 1,000 discharges (pre- NDOCP) and 1.41 per 1,000 discharges (post-NDOCP). (Warren et al. 2019))

Aetna Insurance

Sutter Hospital Systems, Kaiser Permanente, and others are not alone in exploring the potential of oral care to prevent pneumonia. Aetna Insurance has also realized that "Oral hygiene is a weapon against infection" their outreach infection prevention strategy Rush to Brush in collaboration with Johnson and Johnson and Colgate Palmolive, empowers their beneficiaries. They provided 36,000 pre-surgical patients with informational toolkits including toothbrush and toothpaste, and mouthwash packaged in a travel pouch prior to their upcoming hospital stay. Aetna reported a 30% reduction in NVHAP cases for patients who received the oral care kits compared to a sample of patients who did not receive the kits. Aetna Rush to Brush Results

Leadership plan

Hospital governance, senior administrative leadership, clinical leadership, and safety/ risk management leadership need to work collaboratively to reduce hospital acquired pneumonia. To achieve a goal of zero preventable deaths, leaders need to commit to taking these key actions:

- Show leadership's commitment to reducing pneumonia
- Hospital governance and senior administrative leadership must commit to becoming aware of major performance gaps in their own organization.
- Hospital governance, senior administrative leadership, clinical/safety leadership must close their own performance gaps by implementing a comprehensive approach.
- Healthcare leadership must reinforce their commitment by: Taking an active role in

championing process improvement
  - Giving their time attention, and focus
  - Removing barriers
  - Providing necessary resources
- Leadership must demonstrate their commitment and support by
  - Shaping a vision of the future
  - Clearly defining goal
  - Supporting staff as they work through improvement initiatives
  - Measuring results
  - Communication progress towards goals.

Action plan

In order to improve NV-HAP rates in your facility the following toolkits are freely available.

1. HAPPI: **https://pacesetterassociates.com/pneumonia-hai**
2. HAPPEN Toolkit:

   Contact VAHAPPEN@va.gov for information about VA resources including the HAPPEN toolkit. Read more: **https://www.queri.research.va.gov/qnews/nov19/default.cfm?QnewsMenu=article2**
3. Mouth Care Matters- Improving Oral Care in the UK

   The Mouth Care Matters programme aims to create a healthcare team that is more responsive and personalised for patients and deliver better clinical outcomes, bringing an increased awareness of the importance of good mouth care and how it impacts on general health and quality of life. The initiative is relevant for all people who provide personal care to patients in an acute, care home or community setting. This website is the "hub" for access to all of the training materials, posters, documentation and access to training. We hope that you wish to engage with us on our project, and that you find the materials and links on this website of great value. (cited directly from the Mouth Care Matters web site Mouth Care Matters UK

Technology plan

These suggested practices and technologies have shown proven benefit or, in some cases, are the only known technologies for certain tasks. If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider: **patientsafetymovement.org/actionable-solutions/apss-workgroups/technology-vetting/**

Because there are currently no mandates that require hospitals to address NV-HAP, most hospitals do not have electronic health records or data collection to collect process and outcomes measures related to NV-HAP

Consider implementing the following technologies to address NV-HAP in your organization:

System or Practice

ONC Meaningful Use Certified EHR system Electronic Health Record (EHR) System with the following capabilities: • Computerized Provider Order Entry (CPOE) • Drug-drug interaction check • Drug-allergy interaction check • Clinical Decision Support tools (CDS)
Suction Equipment
Information Technology (IT) Systems • IT is essential to ensure that easy-to-use screens are available for staff to record appropriate interventions (such as type and frequency of oral care, mobility, etc.) from the first launch of the quality improvement project
Implement Electronic Measurement of Hand Hygiene Compliance (See APPS #2A to learn more)

Data Collection Tools		
Oral Care Audit Tracker	Nursing staff can use this tool to organize information when conducting audits on oral care completion, staff documentation, and supply availability. Oral care documentation tracking will be automated in the future and tied to health factors in the new VA oral care documentation template for CPRS.	 Oral Care Audit Tracker.docx
NV-HAP Incidence Calculator	This spreadsheet (which you should have already started using in **Step 1, Action 2**: Determine Implementation Approach to calculate baseline NV-HAP incidence) includes built-in formulas in Tab 2 to help you monitor the impact.	See **Step 1, Action 2**: Determine Implementation Approach
Patient Experience Survey (quality improvement, optional)	You can customize and use this Patient Experience Survey to gain insight on inpatient oral care experience. By collecting and analyzing this information throughout implementation (see **Step 6, Action 2**: Administer Surveys), you can improve the practice to provide better quality care for patients.	 Patient Experience Survey.docx

Table 2: Data Collection Tools

Data Collection Tools from the Department of Veterans Affairs only available for individuals who have VA credentials

Measuring outcomes

When considering outcome measures to monitor the success of NV-HAP quality improvement

projects, four key factors are helpful to consider:

1. Measure pre-post process measures selected by the implementation committee. For example, type and frequency of oral care and type of mobility.
2. Clearly define cases of NV-HAP. General administrative data (ICD-10) and the CDC definition (included in the HAPPI toolkit) can be used (See et al. 2016). However, hospitals may set their own definition and data extraction systems provided the definition is consistently applied in pre/post data collection.
3. Collect the pre-post incidence of NV-HAP, patient sociodemographics, units of NV-HAP occurrence, fiscal impact, and discharge disposition as a minimum data set. Hospitals may want to collect more details to guide further interventions.
4. Compare the process implementation data with the outcome data (incidence of NV-HAP)

Conflicts of interest disclosure

Baker and Quinn received initial funding for their work (2014) on NV-HAP from Sage Products LLC/ now Stryker. Baker has served as a consultant to Sunstar GUM, an oral care company.

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

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