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Major Article

Hospital Acquired Pneumonia Prevention Initiative-2: Incidence of nonventilator hospital-acquired pneumonia in the United States

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Background: Because nonventilator hospital-acquired pneumonia (NV-HAP) is understudied, our purpose was to determine the incidence, overall burden, and level of documented pneumonia preventive interventions of NV-HAP in 24 U.S. hospitals.

Methods: This retrospective chart review extracted NV-HAP cases as per the 2014 ICD-9-CM codes for pneumonia not present on admission and the 2013 Centers for Disease Control and Prevention case definition. Patient demographic data, outcomes, and documented preventive interventions were also collected.

Results: We found 1,300 NV-HAP patients who acquired NV-HAP (rate, 0.12-2.28 per 1,000 patient days) across the 21 hospitals that completed the data collection. Most NV-HAP infections (70.8%) were acquired outside of intensive care units (ICUs); 18.8% required transfer into the ICU. In the 24 hours prior to diagnosis, most of the patients did not have fundamental hospital care associated with pneumonia prevention.

Conclusions: This multicenter, nationwide study highlights the significant burden of NV-HAP in the U.S. acute care hospital setting. We found that NV-HAP occurred on every hospital unit, including in younger, healthy patients. This indicates that although some patients are clearly at higher risk, all patients carry some NV-HAP risk. Therapeutic interventions aimed at NV-HAP prevention are frequently not provided for patients in acute care hospitals.

In the last decade, reducing hospital-acquired pneumonia (HAP) and other hospital-acquired infections (HAIs) has been a focus in the United States for both the Medicare payment policy and the National Healthcare Safety Network. Since 2008, monitoring and prevention for device-associated infections, including ventilator-associated pneumonia (VAP), catheter-associated urinary tract infections, and central line–associated bloodstream infections, have resulted in significant decreases in both the incidence and cost of device-associated infections. Currently, only 25% of HAIs result from the 3 most common device-associated infections, and VAP is responsible for only 38% of all HAP cases.[1,2]

Among HAIs, nonventilator HAP (NV-HAP) is emerging as a major patient safety concern that is associated with higher costs than VAP and is equally as dangerous.[3-5] According to the Healthcare Cost and Utilization Project National Inpatient Sample, there are 35-38 million total annual U.S. hospital discharges[6]; of these, 83% are from medical-surgical units and not critical care. Even for patients in the intensive care unit (ICU), only 39.5% receive mechanical ventilation.[7] Using these figures, 32.6-35.4 million U.S. patients are at risk for NV-HAP annually, whereas only 3.6-3.9 million are at risk for VAP.[6]

A 3-year study of HAP in Pennsylvania from 2009-2011 found that NV-HAP affects more people than VAP (5,597 vs 2,299), has a comparable mortality rate (18.7% vs 18.9%), and has higher total costs ($156 million vs $86 million), respectively.[4] Furthermore, a recent

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Conflicts of interest: Subsequent to this study, D.B. was engaged as a speaker for Sage Products, LLC. B.Q. is on the Speaker's Bureau for Sage Products, LLC.

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case-control study found that patients who developed NV-HAP were 8.4 times more likely to die during hospitalization, more likely to require intensive care, 8.0 times more likely to require mechanical ventilation, and had a longer median hospital length of stay (LOS) than patients who did not develop NV-HAP (15.9 vs 4.4 days, respectively).[8] In a further study of a convenience sample of 8 hospitals in Pennsylvania, most health care–associated pneumonia cases were reported outside of a critical care setting (74.1%), the mortality rate of pneumonia patients reached 30.9%, and a quarter of health care–associated pneumonia cases were attributed to aspiration, a cause which could be minimized through nursing activities targeted at aspiration prevention.[9]

Our previous report from the Hospital-Acquired Pneumonia Prevention Initiative (HAPPI-1) highlighted a significant number of unreported NV-HAP cases (1.2-8.9 per 1,000 hospital days) in a convenience sample of 3 U.S. hospitals.[3] After implementation of an evidence-based, oral care protocol aimed at NV-HAP prevention for all acute care patients in 1 hospital, the rate of NV-HAP per 100 patient discharges decreased by 38.8% from 0.5 to 0.3. The overall number of NV-HAP cases was also reduced by 37% during the 12-month intervention period. The avoidance of NV-HAP cases resulted in an estimated 8 lives saved, $1.72 million in costs avoided, and 500 extra hospital days averted during the study time frame.[3] This initiative began in 2012, and we continue to monitor the rates of NV-HAP. As of 2014, a 70% overall reduction in NV-HAP has been achieved hospital-wide, a reduction in NV-HAP of 164 cases, 31 fewer patient deaths, and $5.9 million cost avoidance (Quinn and Baker, 2016, unpublished quality improvement data).

There are several therapeutic interventions associated with the prevention of HAP, most of which are components of hospital care that patients should receive during their stay. These include (1) oral care,[10-13] (2) head of the bed elevation to 30°-45°,[14] (3) patient mobility,[15] (4) use of incentive spirometry,[16] and (5) deep breathing and coughing exercises.[16] However, several studies have demonstrated that basic hospital care associated with pneumonia prevention may be missing from care that patients receive during their hospital stay. The inability to provide all aspects of required hospital care is a concept known as missed care (ie, standard care that is not completed).[17] Missed care is also be referred to as underused care, omitted care, rationed care, failure to maintain, and unfinished care.[18,19] Data from some studies support that a large amount of fundamental care is being missed in U.S. acute care hospitals.[17,19-25] Furthermore, missed hospital care in both U.S. and international studies has been linked to numerous harmful outcomes for patients and increased cost for hospitals.[17] Two recent systematic reviews of these therapeutic interventions to prevent pneumonia found that the use of oral care was associated with the most evidence of benefit. Unfortunately, oral care is among the most frequent type of missed care.[26,27]

The HAPPI-2 study continued our HAPPI program of research, adding to the current body of knowledge of NV-HAP incidence and the essential aspects of therapeutic interventions for pneumonia prevention. Specifically, we sought to look at the incidence and impact of NV-HAP in a group of 24 U.S. hospitals, and included a measurement of the frequency of care associated with pneumonia prevention. We included oral care as a fundamental aspect of pneumonia prevention care because it is (1) well recognized as a strategy for the prevention of VAP, (2) has the largest body of knowledge of all the currently known interventions for NV-HAP prevention, and (3) is consistent with the Centers for Disease Control and Prevention's (CDC) perspective on modifiable risk factors.[28] In addition, it is the only modifiable risk factor that applies to 100% of patients.

It is our hope that the findings from this study will provide a foundation for future research in this critical area of patient safety, and lead to specific clinical measures and refinement of successful pneumonia prevention strategies that can be widely deployed.

Our specific aims included the following: (1) What is the incidence of NV-HAP in a sample of 24 U.S. hospitals as defined by the CDC?; and (2) What is the amount of missed hospital care associated with pneumonia prevention in the 24 hours prior to the diagnosis of NV-HAP in the same sample of 24 U.S. hospitals, specifically frequency of oral care; head of the bed elevation to 30°-45°; if allowed, out of bed ≥2 times; incentive spirometry use; and deep breathing and coughing exercises?

METHODS

Study oversight and hospital selection

Oversight was provided by the National Patient Safety Foundation's (NPSF) National Study Advisory Board for the HAPPI research project. The NPSF distributed a Web-based request for application; responding hospitals were selected through convenience sampling and approved by the NPSF's HAPPI Advisory Council. We elected to engage the NPSF oversight board to maximize transparency and external validity of results and to avoid bias. Hospital selection aimed to provide a representative sample of U.S. geographic regions, hospital size, and hospital type (community, private, profit or nonprofit, and university hospitals). Central institutional review board approval was provided by the Western Institutional Review Board (approval no. 20150684). Study approval was also granted by the Sutter Institute for Medical Research. Each participating hospital had the option of using the Western Institutional Review Board or to obtain institutional review board approval at their own institution.

Inclusion criteria

Hospitals meeting the following inclusion criteria were eligible to participate: (1) no previous hospital-wide NV-HAP monitoring, (2) no specific NV-HAP prevention interventions within the last 5 years, (3) no implemented change in systematic oral care in the last 5 years, and (4) provision of a letter of support from nursing administration. Hospitals were required to have the ability to extract the required electronic medical records data. All adult discharges from all units in the hospitals between January 1, 2014, and December 31, 2014 were reviewed.

Data collection and electronic medical record review

All data were collected through retrospective chart review. Prior to any data collection, all site investigators received webinar training by the coprincipal investigators on the data extraction process. NV-HAP cases were determined using a 2-step process: (1) all cases coded with the 2014 ICD-9-CM codes for pneumonia and not present on admission were extracted; and (2) reported NV-HAP cases were then verified by the site investigators using the 2013 CDC's case definition of pneumonia (eg, positive chest imaging, clinical signs and symptoms, laboratory evidence).[28] Case report forms, developed by content experts and tested in the pilot study,[3] were used to gather patient demographic data, NV-HAP diagnosis, clinical unit of NV-HAP acquisition, patient outcomes, mortality, LOS, 30-day readmission rate, admission and discharge location disposition, and documented nursing care. Individual sites entered their data into REDCap (Vanderbilt University, Nashville, TN), a secure HIPAA, 21 CFT Part 11-compliant Web application for building and managing online surveys and databases.[29] REDCap data collection and analysis was managed by Researcher's Institute for Medical Research. All data were deidentified before entry into REDCap. Each