The Next Big Adventure: Prevention of Hospital Acquired Non-Ventilator Pneumonia

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Disclosures for Kathleen Vollman

- Consultant-Michigan Hospital Association Keystone Center
- Consultant/Faculty for CUSP for MVP—AHRQ funded national study
- Subject matter expert for CAUTI and CLABSI for CMS/HEN 1.0 & 2.0
- Consultant and speaker bureau for Sage Products LLC
- Consultant and speaker bureau for Hill-Rom Inc
- Consultant and speaker bureau for Eloquest Healthcare
Session Objectives

• Understand the significance of health care acquired non-vent pneumonia on patient outcomes

• Define key fundamental evidence based nursing care practices that reduce non-vent HAP

• Discuss strategies to overcome barriers
Why HAI's?
Protecting Patients From Harm

Estimates: 183 Hospitals in 10 States

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HAI:</td>
<td>722,000/year</td>
</tr>
<tr>
<td>HAI-related deaths:</td>
<td>75,000/year</td>
</tr>
<tr>
<td>Hospitalized patients develop infection:</td>
<td>1 out of 25 (4%)</td>
</tr>
<tr>
<td>Death due to sepsis/septic shock:</td>
<td>700/day</td>
</tr>
<tr>
<td>Money spent:</td>
<td>$45 billion/year</td>
</tr>
<tr>
<td>Increase risk of readmission:</td>
<td>27 days vs. 59 days</td>
</tr>
</tbody>
</table>

Table 2. Distribution of 504 Health Care–Associated Infections. *

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Rank</th>
<th>No. of Infections</th>
<th>Percentage of All Health Care–Associated Infections (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia†</td>
<td>1 (tie)</td>
<td>110</td>
<td>21.8 (18.4–25.6)</td>
</tr>
<tr>
<td>Surgical-site infection</td>
<td>1 (tie)</td>
<td>110</td>
<td>21.8 (18.4–25.6)</td>
</tr>
<tr>
<td>Gastrointestinal infection</td>
<td>3</td>
<td>86</td>
<td>17.1 (14.0–20.5)</td>
</tr>
<tr>
<td>Urinary tract infection‡</td>
<td>4</td>
<td>65</td>
<td>12.9 (10.2–16.0)</td>
</tr>
<tr>
<td>Primary bloodstream infection§</td>
<td>5</td>
<td>50</td>
<td>9.9 (7.5–12.8)</td>
</tr>
<tr>
<td>Eye, ear, nose, throat, or mouth infection</td>
<td>6</td>
<td>28</td>
<td>5.6 (3.8–7.8)</td>
</tr>
<tr>
<td>Lower respiratory tract infection</td>
<td>7</td>
<td>20</td>
<td>4.0 (2.5–6.0)</td>
</tr>
<tr>
<td>Skin and soft-tissue infection</td>
<td>8</td>
<td>16</td>
<td>3.2 (1.9–5.0)</td>
</tr>
<tr>
<td>Cardiovascular system infection</td>
<td>9</td>
<td>6</td>
<td>1.2 (0.5–2.5)</td>
</tr>
<tr>
<td>Bone and joint infection</td>
<td>10</td>
<td>5</td>
<td>1.0 (0.4–2.2)</td>
</tr>
<tr>
<td>Central nervous system infection</td>
<td>11</td>
<td>4</td>
<td>0.8 (0.3–1.9)</td>
</tr>
<tr>
<td>Reproductive tract infection</td>
<td>12</td>
<td>3</td>
<td>0.6 (0.2–1.6)</td>
</tr>
<tr>
<td>Systemic infection</td>
<td>13</td>
<td>1</td>
<td>0.2 (0.01–1.0)</td>
</tr>
</tbody>
</table>
Build the Will: NV-HAP?

- HAP 1st most common HAI in U.S.
  - Increased morbidity $\rightarrow$ 50% are not discharged back home
  - Increased mortality $\rightarrow$ 18%-29%
  - Extended LOS $\rightarrow$ 4-9 days
  - Increased Cost $\rightarrow$ $28K$ to $109K$
  - 2x likely for readmission <30 day

## Relative Harm: Most Common HAIs

<table>
<thead>
<tr>
<th>Type</th>
<th>% Prevalence</th>
<th>% Mortality</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTI</td>
<td>13%</td>
<td>1.5%</td>
<td>$1,108</td>
</tr>
<tr>
<td>CLABSI</td>
<td>5-10%</td>
<td>12%</td>
<td>$33,618</td>
</tr>
<tr>
<td>SSI</td>
<td>22%</td>
<td>3%</td>
<td>$19,305</td>
</tr>
<tr>
<td>HAP</td>
<td>22%</td>
<td>19%</td>
<td>$40,000</td>
</tr>
</tbody>
</table>
## Current Literature: NV-HAP is a National Problem in Hospitals

<table>
<thead>
<tr>
<th>Study</th>
<th>Incidence</th>
<th>Mortality</th>
<th>+LOS</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Davis (2012)</td>
<td>5,600 /3 yrs</td>
<td>18.9%</td>
<td>Not queried</td>
<td>$28,000</td>
</tr>
<tr>
<td>HCUP National database (P)</td>
<td>2/100 pts</td>
<td>14.5%</td>
<td>4 days</td>
<td>$36,400</td>
</tr>
<tr>
<td>Magill et al. CDC (2014)</td>
<td>13% of all HAIs</td>
<td>19%</td>
<td>4-9 days</td>
<td>$40,000</td>
</tr>
<tr>
<td>Micek, Chew, Hampton &amp; Kollef (2016)</td>
<td>Matched controls 174 cases NV-HAP</td>
<td>15.5% vs. 1.6%</td>
<td>15.9 days vs. 4.4</td>
<td></td>
</tr>
<tr>
<td>See, et al. (2016)</td>
<td>Retrospective review 8 hospitals in PA 2011-2012 VAP excluded 30% of 838 cases/reviewed by CDC</td>
<td>30.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**References**

Davis, Pt Safety Authority 2012 9(3).
Giuliano, K. et al. (2016) AORN Poster 2016
Magill, S.S. et al. (2014) NEJM. 370(13), p 1198-1208
Micek, et. al. CHEST 2016 Online first
See, et. al. ICHE, 37, pp 818-824
doi:10.1017/ice.2016.74
Hospital-Acquired Pneumonia: Non-Ventilated versus Ventilated Patients in Pennsylvania

- **Purpose:**
  - Compare VAP and NV-HAP incidence, outcomes
- **Methods:**
  - Pennsylvania Database queried
  - All nosocomial pneumonia data sets (2009-2011)

Results:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NO. OF NV-HAP CASES</th>
<th>NO. OF NV-HAP DEATHS</th>
<th>% OF NV-HAP CASES CONTRIBUTING TO DEATH</th>
<th>NO. OF VAP CASES</th>
<th>NO. OF VAP DEATHS</th>
<th>% OF VAP CASES CONTRIBUTING TO DEATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>1,976</td>
<td>363</td>
<td>18.4 (95% CI: 16.5 to 20.3)</td>
<td>922</td>
<td>163</td>
<td>17.7 (95% CI: 15.0 to 20.5)</td>
</tr>
<tr>
<td>2010</td>
<td>1,848</td>
<td>366</td>
<td>19.8 (95% CI: 17.8 to 21.8)</td>
<td>737</td>
<td>144</td>
<td>19.5 (95% CI: 16.3 to 22.7)</td>
</tr>
<tr>
<td>2011</td>
<td>1,773</td>
<td>315</td>
<td>17.8 (95% CI: 15.8 to 19.7)</td>
<td>640</td>
<td>127</td>
<td>19.8 (95% CI: 16.4 to 23.3)</td>
</tr>
<tr>
<td>Total</td>
<td>5,597</td>
<td>1,044</td>
<td>18.7 (95% CI: 17.5 to 19.8)</td>
<td>2,299</td>
<td>434</td>
<td>18.9 (95% CI: 17.1 to 20.7)</td>
</tr>
</tbody>
</table>

Note: NV-HAP refers to nonventilator-hospital-acquired pneumonia and VAP refers to ventilator-associated pneumonia.

- Mortality
- Incidence
- Total deaths
- Total cost
- Wide-spread

Incidence, Prevalence of NV-HAP: A Local Study (2010)

• Purpose:
  – Determine incidence and clinical factors of NV-HAP

• Method:
  – Descriptive, quasi-experimental study using retrospective data
  – Inclusion criteria:
    • All adult discharges
    • ICD-9 codes of pneumonia not POA
    • AND met CDC definition of HAP

NV-HAP SMCS Research Findings: 2010

24,482 patients and 94,247 patient days

Incidence:
• 115 adults
• 62% non-ICU
• 50% surgical
• Average age 66
• Common comorbidities:
   CAD, COPD, DM, GERD
• Common Risk Factors:
   Dependent for ADLs (80%)
   CNS depressant meds (79%)

Cost:
• $4.6 million
• 23 deaths
• Mean Extended LOS 9 days
• 1035 extra days

• 22 U.S. hospitals
• 1300 NV-HAP
  – 18.4% mortality
  – 60% occurred on Med/Surg units
  – 26% transferred to ICU *
  – 33% transferred to ICU died
  – 34% admitted from home were discharged to a higher level of care*
  – 20% readmitted within 30 days*
  – * All cost factors
ICU-Acquired pneumonia: VAP vs. NV-HAP

**Methods:**
- Prospective study of 135 consecutive episodes over 3 years of adults with ICU-acquired pneumonia
- Compared clinical and microbiological characteristics of VAP and NV-HAP

**Results** for VAP & NV-HAP were not statistically different:
- Pathogens
- Comorbid conditions,
- Severity parameters,
- Mortality, and
- Hospital length of stay

Among NV-HAP patients, 79 (52%) needed subsequent intubation
Where is the Highest Risk for NV-HAP?

Rate of Nonventilator Hospital-Acquired Pneumonia

NV-HAP per 1000 patient days

Slide courtesy of Barb Quinn
Not On Your Dashboard Yet? Preventing NV-HAP Addresses Common Quality Metrics

- Mortality: 18.9%
- ICU utilization: 66%
- Length of stay: 4-9 extra days
- 30 day Readmission: 19.3%
- Long term morbidity: 34% d/c LTC
- Sepsis: >50% of all HAP
- Cost: $28K-$40K
Preventing NV-HAP Through Evidence Based Fundamental Care Strategies
Pathogenesis → Prevention

- **Germs in Mouth**
  - Dental plaque provides microhabitat
  - Bacteria replicate 5X/24 hrs

- **Aspirated into Lungs**
  - Most common route
  - 50% of healthy adults micro-aspirate in sleep

- **Weak Defenses**
  - Poor cough
  - Immunosuppressed
  - Multiple co-morbidities

Formation of Biofilm Over 13 Hours

http://helios.bto.ed.ac.uk/bto/microbes/biofilm.htm
Loesche, W. 2012
Pathogenesis → Prevention

- **Germs in Mouth**
  - Dental plaque provides microhabitat
  - Bacteria replicate 5X/24 hrs

- **Aspirated into Lungs**
  - Most common route
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- **Weak Defenses**
  - Poor cough
  - Immunosuppressed
  - Multiple co-morbidities

Micro Aspiration During Sleep in Healthy Subjects

- Prospective duplicate full-night studies
- 10 normal male’s 22-55 yrs of age
- Methods:
  - Radioactive $^{99}$mTc tracer inserted into the nasopharynx
  - Lung scans conducted immediately following final awakening
  - No difference in sleep efficacy between 2 study nights
- Results:
  - 50% of subjects had tracer in the pulmonary parenchyma upon final awakening
  - No difference in age, time spent in bed, efficacy of sleep, apnea-hyponea index, arousal plus awakening index or % sleep in the supine position between subjects that aspirated and those that did not.

Body Position: Supine versus Semi-recumbent (30-45 degrees)

Methodology

- 19 mechanically ventilated patients
- 2 period crossover trial
- Study supine and semirecumbent positions over 2 days
- Labeled gastric contents (Tc 99m sulphur colloid)
- Measured q 30 min content of gastric secretions in endobronchial tree in each position
- Sampled ET secretions, gastric juice & pharyngeal contents for bacteria

Body Position: Supine versus Semi-recumbent (30-45 degrees)

Results

• Radioactive contents higher in endobronchial secretions in supine patients

• Time dependent:
  – Supine: 298cpm/30min vs. 2592cpm/300min
  – HOB: 103cpm/30min vs. 216cpm/300min

• Same microbes cultured in all 3 areas 32% with HOB vs. 68% supine.

Risk Factor Categories for Oral Cavity & Pneumonia

- Factors that increase bacterial burden or colonization
- Factors that increase risk of aspiration
Missed Nursing Care

• “Any aspect of required patient care that is omitted (either in part or whole) or significantly delayed.”
• A predictor of patient outcomes
• Measures the process of nursing care

SORRY WE MISSED YOU!
Hospital Variation in Missed Nursing Care

Figure 2. Elements of care most and least frequently missed. The solid bars represent the means across all 10 hospitals, and the range lines indicate the standard deviations.

Patient Perceptions of Missed Nursing Care

Table 2. Elements of Nursing Care by Ability of Patient to Report and Extent Missed*

<table>
<thead>
<tr>
<th></th>
<th>Fully Reportable</th>
<th>Partially Reportable</th>
<th>Not Reportable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequently Missed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mouth care</td>
<td></td>
<td></td>
<td>Patient assessment</td>
</tr>
<tr>
<td>Listening</td>
<td></td>
<td></td>
<td>Surveillance</td>
</tr>
<tr>
<td>Being kept informed</td>
<td></td>
<td></td>
<td>IV site care</td>
</tr>
<tr>
<td>Sometimes Missed</td>
<td></td>
<td></td>
<td>Ambulation</td>
</tr>
<tr>
<td>Response to call lights</td>
<td></td>
<td></td>
<td>Discharge planning</td>
</tr>
<tr>
<td>Response to alarms</td>
<td></td>
<td></td>
<td>Patient education</td>
</tr>
<tr>
<td>Meal assistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain medication and follow-up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely Missed</td>
<td></td>
<td></td>
<td>Medication administration</td>
</tr>
<tr>
<td>Bathing</td>
<td></td>
<td></td>
<td>Repositioning</td>
</tr>
</tbody>
</table>

* IV, intravenous.

Risk Factors for Oral Bacteria in the Hospital

- Poor oral health in the U.S. (CDC, 2011)
- Increased bacteria counts
  - Plaque, gingivitis, tooth decay
  - Reduced salivary flow
- 24-48 hours for HAP pathogens in mouth
- If aspirated = 100,000,000 bacteria/ml saliva into lungs

Oral Cavity & VAP

- 89 critically ill patients
- Examined microbial colonization of the oropharynx throughout ICU stay
- Used pulse field gel electrophoresis to compare chromosomal DNA
- Results:
  - Diagnosed 31 VAPs
  - 28 of 31 VAP’s the causative organism was identical via DNA analysis

- 49 elderly nursing home residents admitted to the hospital
- Examined baseline dental plaque scores & microorganism within dental plaque
- Used pulse field gel electrophoresis to compare chromosomal DNA
- Results
  - 14/49 adults developed pneumonia
  - 10 of 14 pneumonias, the causative organism was identical via DNA analysis

El-Solh AA. Chest. 2004;126:1575-1582
Impact of Oral Care on HAP

FIGURE 2. Effects of oral care on preventing non-ventilator-associated pneumonia (non-VAP).

FIGURE 3. The effect of mechanical oral care on non-ventilator-associated pneumonia (non-VAP).

Current Evidence for Oral Care Procedure

- **Method:**
  - Review of 7 RCTs and 1 meta-analysis

- **Results:**
  - Toothbrushing removes dental plaque; swabs do not.
  - Chlorhexidine reduces oropharyngeal colonization
  - Chlorhexidine interventions reduce rate of VAP

  - Optimal frequency of basic oral care – unknown

Halm, A. Amer J Crit Care. 2009. 18, 275-278.
SMCS HAP Prevention Plan

Phase 1: Oral Care

- Formation of new quality team: Hospital-Acquired Pneumonia Prevention Initiative (HAPPI)

- New oral care protocol to include non-ventilated patients

- New oral care products and equipment for all patients

- Staff education and in-services on products

- Ongoing monitoring and measurement – Monthly audits

## Gap Analysis

<table>
<thead>
<tr>
<th>Best Practice</th>
<th>Our Gaps</th>
<th>Action To Take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive oral care for all (CDC, SHEA)</td>
<td>ICU vent patients only</td>
<td>Develop inclusive oral care protocol</td>
</tr>
<tr>
<td>Oral CHG (0.12%) periop adult CV surgery and vent pts. (CDC, ATS, IHI)</td>
<td>Not using CHG on these patients.</td>
<td>Added to preprinted orders, and to protocol</td>
</tr>
<tr>
<td>Therapeutic oral care tools (ADA)</td>
<td>Poor quality oral care tools. Absence of denture care supplies.</td>
<td>New tools and supplies.</td>
</tr>
</tbody>
</table>

## Protocol – Plain & Simple

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Tools</th>
<th>Procedure</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Care / Assist</td>
<td>Brush, paste, rinse, moisturizer</td>
<td>Provide tools</td>
<td>4 X / day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brush 1-2 minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rinse</td>
<td></td>
</tr>
<tr>
<td>Dependent / Aspiration Risk</td>
<td>Suction toothbrush kit (4)</td>
<td>Package instructions</td>
<td>4 X / day</td>
</tr>
<tr>
<td>Dependent / Vent</td>
<td>ICU Suction toothbrush kit (6)</td>
<td>Package instructions</td>
<td>6 X / day</td>
</tr>
<tr>
<td>Dentures</td>
<td>Tools + Cleanser Adhesive</td>
<td>Remove dentures &amp; soak</td>
<td>4X / day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brush gums, mouth</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rinse</td>
<td></td>
</tr>
</tbody>
</table>

Ortho Unit had ZERO HAP cases in the last 4 months of 2013!!

Great WORK!!

Remember, the goal is to provide and document oral care after each meal and before bedtime.
NV-HAP Incidence
50 % Decrease from Baseline

Control chart for NV-HAP
January 2010 to December 2013

Open Heart Surgery Patients: NV-HAP Reduced 75%

Oral chlorhexidine periop started
Return on Investment

- 60 NV-HAP avoided Jan 1 – Dec. 31 2013
- $2,400,000 cost avoided
- - 117,600 cost increase for supplies
- $2,282,400 return on investment

- 8 lives saved

控制图非机械通气HAP
2010年1月至2014年12月

- 口腔卫生
  - 全部成年患者

- 文档

- NGT 标准修订

- 药房开始PPI 协议

- 开始手术前的口腔护理

- 强制教育
  - 护士助理

Quinn B, 提供于AACN NTI, Houston, Tx, 2017
Post Operative NV-HAP (all adult inpatient surgery)
Incidence 6 months Pre Oral Care vs. 6 Months After

Quinn B, Presented at AACN NTI, Houston, Tx, 2017
"Even if you are on the right track, you will get run over if you just sit there."

Will Rogers
What is Next?

- Protocol approved by the American Dental Association for hospitals
- Replication study in Quinn's health system of 23 hospitals
- QI replication of study across hospitals in the US
- Creation of a tool kit to drive the change
It is not enough to do your best; you must know what to do, and THEN do your best.

~ W. Edwards Deming
Take the Next Big Adventure