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

• Create the link of patient advocacy to the basic nursing care
• Define key fundamental evidence based nursing care practices that reduce non-vent HAP
• Discuss strategies to overcome barriers
“It may seem a strange principle to enunciate as the very first requirement in a Hospital that it should do the sick no harm.”

Florence Nightingale

Advocacy = Safety
PROTECT THE PATIENT FROM BAD THINGS HAPPENING ON YOUR WATCH

Implement Interventional Patient Hygiene
Interventional Patient Hygiene

- Hygiene…the science and practice of the establishment and maintenance of health
- Interventional Patient Hygiene….nursing action plan directly focused on fortifying the patients host defense through proactive use of evidence based hygiene care strategies

Comprehensive Oral Care Plan

Incontinence Associated Dermatitis Prevention Program

Pressure Ulcer Prevention

Catheter Care

Bathing & Assessment

Hand Hygiene
INTERVENTIONAL PATIENT HYGIENE (IPH)

HAND

HYGIENE

VAP/HAP

Oral Care/Mobility

Catheter Care

Skin Care/Bathing/Mobility

CA-UTI

CA-BSI

SSI

Falls

HASI

Achieving the Use of the Evidence

Factors Impacting the ability to Achieve Quality Nursing Outcomes at the Point of Care

Vollman KM. Australian Crit Care, 2009;22(4): 152-154
Building Resiliency Into Interventions

Forcing functions and constraints

Automation and computerization

Standardization and protocols

Checklists and independent check systems

Rules and policies

Education and information

Vague warnings – Be more careful!

*Strongest:

*Weakest:
Why HAI's?
Protecting Patients From Harm

<table>
<thead>
<tr>
<th>Estimates: 183 Hospitals in 10 States</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HAI:</strong></td>
</tr>
<tr>
<td><strong>HAI-related deaths:</strong></td>
</tr>
<tr>
<td><strong>Hospitalized patients develop infection:</strong></td>
</tr>
<tr>
<td><strong>Death due to sepsis/septic shock:</strong></td>
</tr>
<tr>
<td><strong>Money spent:</strong></td>
</tr>
<tr>
<td><strong>Increase risk of readmission:</strong></td>
</tr>
</tbody>
</table>

Economic Burden of HAI’s: Build The Business Case

• Generated point estimates for attributable cost & LOS
• 5 Major Infections=9.8 billion
  • SSI’s, CLABSI’s, VAP/VAE, CAUTI’s, C-Diff
  • SSI’s (33.7%)
  • VAP (31.6%)
  • CLA-BSI (18.9%)
  • C-Diff (15.4%)
  • CA-UTI <1%

Per Case Basis

<table>
<thead>
<tr>
<th>SSI</th>
<th>CLABSI</th>
<th>VAP</th>
<th>CAUTI</th>
<th>C-Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20,785</td>
<td>$45,814</td>
<td>$40,144</td>
<td>$896</td>
<td>$11,285</td>
</tr>
</tbody>
</table>

50% HAI’s Preventable
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>
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
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></td>
<td>Mouth care</td>
<td>Ambulation</td>
<td>Patient assessment, Surveillance, IV site care</td>
</tr>
<tr>
<td>Frequently Missed</td>
<td>Listening</td>
<td>Discharge planning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Being kept informed</td>
<td>Patient education</td>
<td></td>
</tr>
<tr>
<td>Sometimes Missed</td>
<td>Response to call lights</td>
<td>Medication administration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Response to alarms</td>
<td>Repositioning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meal assistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pain medication and follow-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely Missed</td>
<td>Bathing</td>
<td>Vital signs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hand washing</td>
<td></td>
</tr>
</tbody>
</table>

* IV. intravenous.

Source Control: The Oral Cavity as a Risk Factor in NV-HAP and VAP
Build the Will: NV-HAP?

- HAP 1st most common HAI in U.S.
  - Increased morbidity → 50% are not discharged back home
  - Increased mortality → 18%-29%
  - Extended LOS → 4-9 days
  - Increased Cost → $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% 8.4 more likely to die</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</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

IMPACT
HAPPI-2 Preliminary Analysis

• 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

Quinn & Baker, Publ Pend 2016
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% discharged SNF S
• Sepsis >50% of all HAP
• Cost $28K-$40K
Preventing NV-HAP Through Evidence Based Fundamental Nursing 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

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)

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.

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
“A person can’t have good general health without good oral health.” -  

Former US Surgeon General C. Everett Koop
Procedure 4: Endotracheal Tube Care and Oral Care

Authors:
Kathleen M Vollman
Mary Lou Sole
Barbara Quinn
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 through out 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
Formation of Biofilm Over 13 Hours

http://helios.bto.ed.ac.uk/bto/microbes/biofilm.htm
Loesche, W. 2012
This attachment structure requires mechanical removal with a good toothbrush.
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.
Who is “at-risk”? ALL patients in the hospital – therefore a standard of care is required
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>

Denture Care

• Patients should never sleep in dentures
  – If patient refuses, remove for 3-4 hours during day

• Dentures **should** be kept in liquid if not in mouth
  – Cleaning tablets should not be used with persons who have dementia
  – Dentures should be rinsed well before placing in patient’s mouth

• Daily brushing with a denture brush and liquid soap
  – Not toothpaste
Provide Meaningful Data

- 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.

Used with permission from Barbara Quinn
NV-HAP Incidence
50 % Decrease from Baseline

Control chart for NV-HAP
January 2010 to December 2013

Number of non-ventilator HAP cases

Open Heart Surgery Patients: NV-HAP Reduced 75%

Oral chlorhexidine periop started

Used with permission from Barbara Quinn
Return on Investment

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

- 8 lives saved

PRICELESS

NV-HAP 70% from baseline!

Control chart for non-ventilator HAP
January 2010 to December 2014

- Oral care for all adult pts
- Documentation
- NGT standards revised
- Pharmacy starts PPI protocol
- Started oral care prior to surgery

Number of non-ventilator HAP cases

Quinn B, Presented at 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
NV-HAP in the US

• **Aim 1:** Add to the body of knowledge on National Incidence of NV-HAP in the U.S.

• **Aim 2:** Provide a broad descriptive overview of relevant data related to NV-HAP to provide a foundation for additional scientific inquiry.
HCUP-NIS (2012)

• The Healthcare Cost and Utilization Project National Inpatient Sample (HCUP-NIS) is a database containing a sample of inpatient records in a given year.

• Contains information about billing, patient demographics, diagnosis & procedure codes, mortality risk, disease severity and transfer information.

• HCUP database comprises the largest collection of longitudinal data on hospital care in the U.S.

• Secondary analyses with the HCUP-NIS was used to address our research aims.
CDC Criteria

- Using only patients with a 48+ LOS
- N=119,075
  - NV-HAP
  - CAP/AP
  - Unmatched random
  - Matched random (mortality & illness acuity)
- VAP: N=3,420
- Pneumonia readmission rate: 15.5%
  - AHRQ, 2013
## Descriptive Data

<table>
<thead>
<tr>
<th></th>
<th>NV-HAP</th>
<th>CAP</th>
<th>Unmatched</th>
<th>Matched</th>
<th>VAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total charges (in thousands)</td>
<td>121.44</td>
<td>31.86</td>
<td>37.97</td>
<td>88.40</td>
<td>383.64</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>11.8</td>
<td>4.90</td>
<td>4.5</td>
<td>9.1</td>
<td>30.2</td>
</tr>
<tr>
<td>Patient mortality (%)</td>
<td>14.8%</td>
<td>3.2%</td>
<td>1.8%</td>
<td>14.4%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>67</td>
<td>68.8</td>
<td>57.1</td>
<td>67.6</td>
<td>55.7</td>
</tr>
<tr>
<td>Chronic conditions (%)</td>
<td>7.4</td>
<td>5.6</td>
<td>4.8</td>
<td>7.5</td>
<td>7.0</td>
</tr>
<tr>
<td>OR procedure (%)</td>
<td>20.7%</td>
<td>2.2%</td>
<td>29.7%</td>
<td>21.9%</td>
<td>5.2%</td>
</tr>
</tbody>
</table>
# Transfer Status

<table>
<thead>
<tr>
<th></th>
<th>NV-HAP</th>
<th>CAP</th>
<th>Unmatched</th>
<th>Matched</th>
<th>VAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>µ</td>
<td>µ</td>
<td>µ</td>
<td>µ</td>
<td>µ</td>
</tr>
<tr>
<td>Transfer in from another HC Facility</td>
<td>5.4%</td>
<td>4.0%</td>
<td>2.7%</td>
<td>5.3%</td>
<td>7.9%</td>
</tr>
<tr>
<td>Transfer out to another HC facility</td>
<td>34.5%</td>
<td>20.1%</td>
<td>15.3%</td>
<td>32.5%</td>
<td>52.2%</td>
</tr>
<tr>
<td>Delta</td>
<td>29.1%</td>
<td>16.1%</td>
<td>12.6%</td>
<td>27.2%</td>
<td>44.3%</td>
</tr>
</tbody>
</table>
Cost Overview

<table>
<thead>
<tr>
<th></th>
<th>US Healthcare Charges (Acute Care)</th>
<th>Acute Care Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>NV-HAP</td>
<td>$16,224,186,937</td>
<td>$4,857,540,999</td>
</tr>
<tr>
<td>Matched</td>
<td>$11,809,720,515</td>
<td>$3,535,844,466</td>
</tr>
<tr>
<td>Random</td>
<td>$5,072,571,423</td>
<td>$1,518,733,959</td>
</tr>
<tr>
<td>CAP</td>
<td>$4,255,895,837</td>
<td>$1,274,220,310</td>
</tr>
<tr>
<td>VAP</td>
<td>$1,312,059,060</td>
<td>$392,832,054</td>
</tr>
</tbody>
</table>

• Overall NV-HAP cost greater than all comparison groups
• It may be a more significant public health issue than CAP
• NV-HAP should be elevated to the same level of concern, attention, and effort as prevention of VAP.
# Literature: Pneumonia and Sepsis

50% of sepsis cases are caused by pneumonia (Finfer, 2013)

### Table 4. Common sites of infection in patients with severe sepsis by sex and associated crude mortality rates (based on Mayr et al.)

<table>
<thead>
<tr>
<th>Site of infection</th>
<th>Frequency (%)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Respiratory</td>
<td>41.8</td>
<td>35.8</td>
</tr>
<tr>
<td>Bacteremia, site unspecified</td>
<td>21.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>10.3</td>
<td>18.0</td>
</tr>
<tr>
<td>Abdominal</td>
<td>8.6</td>
<td>8.1</td>
</tr>
<tr>
<td>Device-related</td>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Wound/soft tissue</td>
<td>9.0</td>
<td>7.5</td>
</tr>
<tr>
<td>Central nervous system</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Endocarditis</td>
<td>0.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Other/ unspecified</td>
<td>6.7</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Non-ventilator Hospital-acquired versus Pneumonia on Admission in Patients who Develop Sepsis: Incidence and Cost

• Pneumonia is a known risk factor for sepsis, and the Agency for Healthcare Research and Quality estimates the cost of sepsis at $20 billion (2011), with incidence increasing annually by 11.9%.

• Our objective was to compare incidence and cost in 2 groups of pneumonia patients with sepsis: patients with NV-HAP and patients admitted with pneumonia (AP)
Methods

• We used the 2012 Healthcare Utilization Project (HCUP) National Inpatient Sample (NIS).
• We included patients with NV-HAP & 48+ hour LOS (N=119,075); and AP, randomly selected to match the NV-HAP group size.
• Within each group we then found the sepsis cases
  – ICD-9: 995.91 & 995.92
<table>
<thead>
<tr>
<th>NV-HAP</th>
<th>AP</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=43,252</td>
<td>N=2,332</td>
</tr>
<tr>
<td>Sepsis incidence=36.4%</td>
<td>Sepsis incidence=1.9%</td>
</tr>
<tr>
<td>Age (yrs): 66.4</td>
<td>Age (yrs): 68.4</td>
</tr>
<tr>
<td>Chronic diseases: 7.4</td>
<td>Chronic diseases: 6.8</td>
</tr>
<tr>
<td>LOS (days): 15.9</td>
<td>LOS (days): 12.4</td>
</tr>
<tr>
<td>Total charges: $168,383</td>
<td>Total charges: $113,209</td>
</tr>
<tr>
<td>Mortality: 20.5% (N=8847)</td>
<td>Mortality: 26.8% (N=626)</td>
</tr>
<tr>
<td>Surgical: 21.2% (N=9192)</td>
<td>Surgical: 9.4% (N=219)</td>
</tr>
<tr>
<td>Another healthcare facility:</td>
<td>Another healthcare facility:</td>
</tr>
<tr>
<td>– Transfer in: 7.3%</td>
<td>– Transfer in: 6.0%</td>
</tr>
<tr>
<td>– Transfer out: 39.4%</td>
<td>– Transfer out: 29.5%</td>
</tr>
<tr>
<td>– Delta: 32.1%</td>
<td>– Delta: 23.5%</td>
</tr>
</tbody>
</table>

Giuliano K, Quinn, B presented at 2017 NTI Houston TX.
VAP

- VAP cases: N=3420
- VAP with sepsis: N=1407
- Incidence: 43%
- VAP sepsis mortality: 26.4%
- Total hospital charges per cases (mean) – $422,674
Logistic Regression

- Used both chronic disease and pneumonia type as IV
- Patients who develop NV-HAP are 28.8 times more likely to develop sepsis than patients with AP.
## Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>Mean Hospital Charges per case</th>
<th>Total number sepsis cases</th>
<th>Total hospital charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>NV-HAP</td>
<td>$ 168,383</td>
<td>$ 43,252</td>
<td>$ 7,282,901,516</td>
</tr>
<tr>
<td>AP</td>
<td>$ 113,209</td>
<td>$ 2,332</td>
<td>$ 264,003,388</td>
</tr>
<tr>
<td>VAP</td>
<td>$ 422,674</td>
<td>$ 1,407</td>
<td>$ 594,702,318</td>
</tr>
</tbody>
</table>
Conclusions

- NV-HAP contributes more to sepsis than both AP & VAP
  - Cost
  - Mortality
  - Need for post-acute care
- NV-HAP prevention is likely to contribute to a reduction in sepsis
WHEN WOULD NOW BE A GOOD TIME TO DO THIS?

It is not enough to do your best; you must know what to do, and THEN do your best.

~ W. Edwards Deming
Driving Change

- Gap analysis
- Build the Will
- Protocol Development

- Make it Prescriptive
- Overcoming barriers
- Daily Integration

Structure + Process → Outcomes
Take the Next Big Adventure
Be Courageous

We all are responsible for the safety of our patients......Own the Issues

• “If not this, then what??”
• “If not now, then when?”
• “If not me, then who??”