Target Zero: Mitigating Risk factors for Preventing Hospital Acquired Infections

Kathleen M. Vollman MSN, RN, CCNS, FCCM, FCNS, FAAN
Clinical Nurse Specialist / Educator / Consultant
ADVANCING NURSING
kvollman@comcast.net
Northville Michigan
www.Vollman.com

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Disclosures for Kathleen Vollman

- Consultant-Michigan Hospital Association Keystone Center
- Subject matter expert for CAUTI and CLABSI, HAPI, C-Diff and Sepsis for CMS/HIIN
- Consultant and speaker bureau:
  - Sage Products LLC
    - Will be addressing an off label use of a 2% CHG pre-op prep cloth
  - Eloquest Healthcare
  - Urology division of Medline Industries
Session Objectives

• Identify modes of transmission for the spread of microorganism in the healthcare environment

• Evaluate key evidence based care practices that can reduce bacterial load
"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
INTERVENTIONAL PATIENT HYGIENE (IPH)

VAP/HAP

Oral Care/
Mobility

VAP/HAP

HAND HYGIENE
CLEAN GLOVES

PATIENT
CLEAN GLOVES

HAND HYGIENE

Catheter Care

Skin Care/
Bathing/Mobility

CA-UTI

CLA-BSI

SSI

Falls

HASI

HAI’s in Australia: One of The 10 National Quality and Safety Standards

- Systematic review from 2010-2016
  - 71,186 urinary tract infections
  - 4902 Clostridium difficile infections
  - 3946 surgical site infections
  - 1962 respiratory infections in acute stroke patients
  - 1100 hospital-onset Staphylococcus aureus bacteremia
  - Incomplete data on common infections such as pneumonia, gastroenterological and bloodstream infection,

Est 165,000 Australians contract infections in hospitals every year

60,037 hospital-acquired infections were diagnosed in Australian public hospitals, affecting one in every 74 hospitalisations (2015-2016).

### HAC’s/HAI’s

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pressure injury</td>
<td>2,831</td>
<td>2,965</td>
<td>3,393</td>
<td>4,369</td>
</tr>
<tr>
<td>2</td>
<td>Falls resulting in fracture or other intracranial injury</td>
<td>1,614</td>
<td>1,764</td>
<td>1,930</td>
<td>2,036</td>
</tr>
<tr>
<td>3</td>
<td>Healthcare associated infection</td>
<td>51,803</td>
<td>54,131</td>
<td>56,692</td>
<td>61,297</td>
</tr>
<tr>
<td>4</td>
<td>Surgical complications requiring unplanned return to theatre</td>
<td>8,165</td>
<td>8,324</td>
<td>8,946</td>
<td>9,135</td>
</tr>
<tr>
<td>5</td>
<td>Unplanned intensive care unit admission</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>6</td>
<td>Respiratory complications</td>
<td>5,742</td>
<td>9,218</td>
<td>10,260</td>
<td>10,700</td>
</tr>
<tr>
<td>7</td>
<td>Venous thromboembolism</td>
<td>3,122</td>
<td>3,150</td>
<td>3,387</td>
<td>3,437</td>
</tr>
<tr>
<td>8</td>
<td>Renal failure</td>
<td>863</td>
<td>859</td>
<td>994</td>
<td>981</td>
</tr>
<tr>
<td>9</td>
<td>Gastrointestinal bleeding</td>
<td>5,559</td>
<td>5,637</td>
<td>6,224</td>
<td>6,330</td>
</tr>
<tr>
<td>10</td>
<td>Medication complications</td>
<td>7,620</td>
<td>10,249</td>
<td>12,517</td>
<td>13,725</td>
</tr>
<tr>
<td>11</td>
<td>Delirium</td>
<td>17,119</td>
<td>19,319</td>
<td>21,478</td>
<td>23,033</td>
</tr>
</tbody>
</table>

HAIs are one of the most common complications affecting hospital patients; they increase the risk of morbidity, mortality & readmission within 12 months.
What If!!!

Around 61,862 healthcare-associated infections occur each year in Australian public hospitals.

If we reduce the rate to the level of the best 25% of peer hospitals:

- In Principal Referral Hospitals: 138.4
- In Public Acute Group A: 84.9
- In Public Acute Group B: 52

This would result in 11,142 fewer healthcare-associated infections with a possible value capture of 229,992 bed days valued at $459,984,691.
MEET THE HOSPITAL STAPH

EMPLOYEES MUST WASH HANDS BEFORE RETURNING TO WORK.

STREP

MRSA

CONCEPT-MIKE ADAMS ART-DAN BERGER WWW.NATURALNEWS.COM
MDRO In Australia

Multi-resistant organism (MRO) refers to bacteria that are resistant to one or more classes of antimicrobial agents and usually are resistant to all but one or two commercially available antimicrobial agents.

Around 3,800 hospital-acquired MROs occur each year in Australian hospitals.

31.6
Highest rate at Principal Referral Hospitals

8.9
Aggregate rate at Principal Referral Hospitals Per 10,000 hospitalisations

If all hospitals reduced their rate to less than 8.9 per 10,000 hospitalisations, it would prevent at least 791 MROs

The cost associated Multi-resistant organism (MRO) in Australia Could cost the hospital an additional $61,390

Patients with this HAC require 29.6 extra days in the hospital compared to those who don’t.
HAI in the ICU was the patients’ endogenous flora (40%-60%); cross-infection via the hands of health care personnel (HCP; 20%-40%); antibiotic-driven changes in flora (20%-25%); and other (including contamination of the environment; 20%). Weinstein RA.. Am J Med 1991;91(Suppl):179S-184S.
Vertical vs. Horizontal

• Vertical approach refers to a narrow-based program focusing on a single pathogen (selective of the specific MDRO)
  – AST to identify carriers
  – Implementation of measures aimed at preventing transmission from carriers to other patients
    • Isolation
    • Hand hygiene

• Horizontal approach to infection prevention and control measures refers to broad-based approaches attempting reduction of all infections due to all pathogens
  – no screening
  – Universal nasal coverage
  – CHG bathing
  – No isolation
  – Limit lines/tubes
  – Hand hygiene

Reducing MDRO’s/HAI’s

Hand Hygiene

Decontamination of Environment

Patient Decolonization

Contact Precautions/Isolation

Antibiotic Stewardship

Practice Device Bundles

Reducing Bacterial Load on the Patient: A Horizontal Strategy

Patient Decolonization

Evidence Based Bathing Practices
Polling question

Based on the current evidence, what type of daily bathing should be performed with critically ill patients:

- Soap and water bath
- Antisepsis CHG bath
- Packaged bath cloths
- Package cloths that are activated by water
Traditional Bathing

Why are there so many bugs in here?

Soap and water basin bath was an independent predictor for the development of a CLABSI
Bath Basins
Potential Source of Infection

Large multi-center study evaluates presence of multi-drug resistant organisms

Total hospitals: 88
Total basins: 1103

- Contaminated: 62%
  686 basins/88 hospitals

- Colonized w/ VRE: 35%
  385 basins/80 hospitals

- Gram negative bacilli: 45%
  495 basins/86 hospitals

- MRSA: 3%
  36 basins/28 hospitals

Mechanisms of Contamination

- Skin flora
- Multiple-use basins
  - Incontinence cleansing
  - Emesis
  - Product storage
- Bacterial biofilm from tap water

Biofilms are ubiquitous
Understanding Water

• All water with the exception of sterile water and filtered water is contaminated with microbes (e.g., potable water, tap water, showers, and ice).
• In healthy persons, contact or ingestion of such water rarely leads to infection.
• However, contact or ingestion of such water may cause infection in immunocompromised persons or when applied to non-intact skin.
• Transmission of these pathogens from a water reservoir may occur by direct and indirect contact, ingestion and aspiration of contaminated water, or inhalation of aerosols*

Presented at MSIPC October 6th, 2016, Lansing MI by Dorine Berriel-Cass
Waterborne Infection

Hospital Tap Water

- Bacterial biofilm
- Most overlooked source for pathogens
- 29 studies demonstrate an association with HAIs and outbreaks
- Transmission:
  - Drinking
  - Bathing
  - Rinsing items
  - Contaminated environmental surfaces
- Immunocompromised patients at greatest risk

Impact on UTI with Basin Bathing

UTI Rate - Removal of Prepackaged Bath Product QTR 3 FY05

The Effect of Bathing with Basin and Water and UTI Rate, LOS and Costs

<table>
<thead>
<tr>
<th>Unit Census: 14</th>
<th>Phases</th>
<th>Product Cost/No. of UTI</th>
<th>Median(^4) LOS 17 Days</th>
<th>Median(^4) Cost (4857.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I- Pre-Packaged Bathing Washcloths (9 months)</td>
<td>$10,530(^1) ($3.00)</td>
<td>25</td>
<td>175</td>
<td>$117,175</td>
</tr>
<tr>
<td>II- Basin/Water (9 months)</td>
<td>$3,510(^2) ($1.00)</td>
<td>48</td>
<td>336</td>
<td>$224,916</td>
</tr>
<tr>
<td>III- Additional Product Cost, UTI, LOS, COSTS</td>
<td>$7,020</td>
<td>23(^3)</td>
<td>151</td>
<td>$107,741</td>
</tr>
</tbody>
</table>

\(^1\)Based on 3 packages of 8 towels each  \(^2\)Based on product cost of towels, soap, and basin  \(^3\)Difference between phase I pre-package/phase II basin water  

Bathing with CHG Basinless Cloths

- Prospective sequential group single arm clinical trial
- 1787 patients bathed
  - Period 1: soap & water
  - Period 2: CHG basinless cloth bath*
  - Period 3: non-medicated basinless cloth bath

*2% CHG cloth for bathing is considered an off-label use of the product.

Veron MO et al. Archives Internal Med 2006;166:306-312
26 colonization's with VRE per 1000 patients days vs. 9 colonization's per 1000 patient days with CHG bath
Impact on VRE with 2% CHG Cloth Bathing*

*2% CHG cloth for bathing is considered an off-label use of the product.

Veron MO et al. Archives Internal Med 2006;166:306-312
The Efficacy of Daily Bathing with Chlorhexidine for Reducing Healthcare-Associated Bloodstream Infections: A Meta-analysis

John C. O’Horo, MD;1 Germana L. M. Silva, MD;2 L. Silvia Munoz-Price, MD;3 Nasia Safdar, MD, PhD4

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Events</th>
<th>Control Events</th>
<th>Total</th>
<th>Weight</th>
<th>Odds Ratio M–H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.1 CHG Bathing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borer et al, 2007</td>
<td>2</td>
<td>1600</td>
<td>15</td>
<td>1923</td>
<td>3.3% 0.16 [0.04, 0.70]</td>
</tr>
<tr>
<td>Camus et al, 2005</td>
<td>6</td>
<td>1991</td>
<td>7</td>
<td>1951</td>
<td>5.3% 0.84 [0.28, 2.52]</td>
</tr>
<tr>
<td>Climo et al, 2009</td>
<td>14</td>
<td>15472</td>
<td>41</td>
<td>15225</td>
<td>10.5% 0.34 [0.18, 0.62]</td>
</tr>
<tr>
<td>Gould et al, 2007</td>
<td>171</td>
<td>6664</td>
<td>264</td>
<td>6899</td>
<td>17.1% 0.66 [0.54, 0.80]</td>
</tr>
<tr>
<td>Munoz-Price et al, 2009</td>
<td>29</td>
<td>7632</td>
<td>59</td>
<td>6210</td>
<td>13.1% 0.40 [0.25, 0.62]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>33359</td>
<td>32218</td>
<td></td>
<td>49.3% 0.47 [0.31, 0.71]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>222</td>
<td>386</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.12; Chi² = 11.07, df = 4 (P = 0.03); I² = 64%
Test for overall effect: Z = 3.53 (P = 0.0004)

* 1.2.2 CHG Impregnated Cloths

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Events</th>
<th>Control Events</th>
<th>Total</th>
<th>Weight</th>
<th>Odds Ratio M–H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleasedale et al, 2007</td>
<td>9</td>
<td>2210</td>
<td>22</td>
<td>2119</td>
<td>8.2% 0.39 [0.18, 0.85]</td>
</tr>
<tr>
<td>Dixon and Carver, 2010</td>
<td>8</td>
<td>3148</td>
<td>27</td>
<td>3346</td>
<td>8.0% 0.31 [0.14, 0.69]</td>
</tr>
<tr>
<td>Evans et al, 2010</td>
<td>4</td>
<td>1785</td>
<td>15</td>
<td>1904</td>
<td>5.2% 0.28 [0.09, 0.85]</td>
</tr>
<tr>
<td>Holder and Zellinger, 2009</td>
<td>2</td>
<td>2000</td>
<td>12</td>
<td>3333</td>
<td>3.3% 0.28 [0.06, 1.24]</td>
</tr>
<tr>
<td>Montecalvo et al, 2010</td>
<td>27</td>
<td>13864</td>
<td>57</td>
<td>12603</td>
<td>12.8% 0.43 [0.27, 0.68]</td>
</tr>
<tr>
<td>Popovich et al, 2009</td>
<td>2</td>
<td>5610</td>
<td>19</td>
<td>6728</td>
<td>3.4% 0.13 [0.03, 0.54]</td>
</tr>
<tr>
<td>Popovich et al, 2010</td>
<td>17</td>
<td>5799</td>
<td>19</td>
<td>7366</td>
<td>9.8% 1.14 [0.59, 2.19]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>34416</td>
<td>37399</td>
<td></td>
<td>50.7% 0.41 [0.25, 0.65]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>69</td>
<td>171</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.19; Chi² = 12.80, df = 6 (P = 0.05); I² = 53%
Test for overall effect: Z = 3.78 (P = 0.0002)

Total (95% CI)                | 67775               | 69617          | 100.0% | 0.44 [0.33, 0.59] |

Total events                  | 201                 | 557            |        |                |

Heterogeneity: Tau² = 0.13; Chi² = 26.12, df = 11 (P = 0.006); I² = 58%
Test for overall effect: Z = 5.39 (P < 0.00001)
Test for subgroup differences: Chi² = 0.19, df = 1 (P = 0.66), I² = 0%

*2% CHG cloth for bathing is considered an off-label use of the product

Infect Control Hosp Epidemiol 2012;33(3):257-267
The Evidence: Impact of 2% CHG Cloth Baths*

Evaluate effect of daily bathing with CHG on acquisition of MDRO’s and incidence of CLABSI

9ICU’s & Bone Marrow Transplant unit
Randomly assigned 7727 patient:
  a. No-rinse, 2% CHG impregnated washcloths*
  b. Non-antimicrobial, no-rinse bath cloths

Results of 2% CHG bathing

- 23% reduction
- 28% reduction
- 50% reduction
- 90% reduction


*2% CHG cloth for bathing is consider an off label use of the product
Impact of 2% CHG Cloth Baths*
Study to determine the best method for reducing spread of MRSA & MDROs

3 protocols tested:

a) Swab for MRSA on admission to ICU
   - Isolate if positive

b) Swab for MRSA on admission to ICU
   - Isolate if positive
   - Nasal mucopiricin x 5 days
   - 2% CHG cloth* bathing for entire ICU stay

c) No swab
   - Nasal mucopiricin x 5 days
   - 2% CHG bath* for entire ICU stay

*2% CHG cloth for bathing is considered an off-label use of the product

Results: No Swab Group
Universal Decolonization Demonstrated

- 37% reduction
- 44% reduction

99 decolonization to prevent 1 CLABSI

Chlorhexidine Bathing and Health Care-Associated Infections
A Randomized Clinical Trial

<table>
<thead>
<tr>
<th>Setting</th>
<th>5 ICUs at 1 academic center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Studied</td>
<td>2% CHG washcloths</td>
</tr>
<tr>
<td>Study period/design</td>
<td>13 months/&quot;Pragmatic Cluster Crossover&quot; RCT</td>
</tr>
<tr>
<td>N</td>
<td>9,340 patients; 39,922 pt days</td>
</tr>
<tr>
<td>Outcome(s) Studied</td>
<td>Composite of CLABSI, CAUTI, VAP (new VAE definition), and C. difficile; Secondary: HA-BSI, clinical MDRO cultures, blood culture contamination</td>
</tr>
<tr>
<td>Results</td>
<td>Non-significant: 2.86 vs. 2.90 per 1000 pt days</td>
</tr>
</tbody>
</table>

Industry Support? None

Figure 2. Effect of Chlorhexidine Bathing on Primary and Secondary Outcomes

## Difference Between Climo & Noto Study

<table>
<thead>
<tr>
<th></th>
<th>Climo</th>
<th>Noto</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcomes</strong></td>
<td>Hospital-acquired MDROs and hospital-acquired BSI</td>
<td>Composite (CLABSI, CAUTI, VAP, C. diff)</td>
</tr>
<tr>
<td><strong>Multicenter Study</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Active surveillance for MDRO acquisition</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Audit of Bathing Compliance</strong></td>
<td>Yes (product usage data)</td>
<td>No</td>
</tr>
<tr>
<td><strong>Training on Bathing</strong></td>
<td>Yes at study start</td>
<td>No</td>
</tr>
<tr>
<td><strong>Analysis Concerns</strong></td>
<td>Adequate adjustment for clustering?</td>
<td>Patient-level analysis; Adequate power with crossover design?</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td>Oral CHG in place for VAP prevention</td>
</tr>
</tbody>
</table>

CHG vs. Routine Bathing to Prevent MDRO and CLABSI in General Medical & Surgical Units

- 53 hospitals in 14 states
- Compared routine bathing (non-medicated disposable cloth or showering) to decolonization with universal chlorhexidine and targeted nasal mupirocin in non-critical-care units.
- 12-month baseline period, 2 month phase, 21 month intervention

Decolonization with universal chlorhexidine bathing and targeted mupirocin for MRSA carriers did not significantly reduce multidrug-resistant organisms in non-critical-care patients.

Patients with medical devices had a 32% greater reduction in all cause bacteremia and a 37% greater reduction in MRSA or VRE clinical cultures compared with the routine care group.

*2% CHG cloth for bathing is considered an off-label use of the product.
Universal Decolonization in an Australian Quaternary ICU

(Dawkins J, et al. Presented at AAACN Annual Scientific Meeting, 2018 Gold Coast)

- Royal Adelaide Hospital ICU
- Prior to 2014 experience stagnating CLABSI rates in ↑In MDRO’s
- Implementation: Sept 2014 2% CHG cloth bathing & first 5 days mupirocin in the nose
- Change practice from CHG soap and water to CHG cloths
- Routine screening procedures for MRSA & VRE (admission and weekly screening)

<table>
<thead>
<tr>
<th></th>
<th>% Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total BSI (including S. aureus)</td>
<td>↓41%</td>
</tr>
<tr>
<td>S. aureus BSI</td>
<td>↓81%</td>
</tr>
<tr>
<td>Total MRO</td>
<td>↓20%</td>
</tr>
<tr>
<td></td>
<td>↓42%</td>
</tr>
<tr>
<td>MRSA</td>
<td>↓28%</td>
</tr>
<tr>
<td></td>
<td>↓68%</td>
</tr>
<tr>
<td>VRE</td>
<td>↓36%</td>
</tr>
<tr>
<td></td>
<td>↓43%</td>
</tr>
<tr>
<td>MRGN</td>
<td>↓13%</td>
</tr>
<tr>
<td></td>
<td>↓24%</td>
</tr>
</tbody>
</table>
Differential Effects of Chlorhexidine Skin Cleansing Methods


- Prospective, randomized 2-center study with blinded assessment.
- To determine whether 3 different CHG skin cleansing methods yield similar residual CHG concentrations and bacterial densities on skin.

Method A - 2% CHG cloth
Method B - 4% CHG liquid poured onto non-medicated cloth
Method C - 4% CHG liquid on cotton wash cloth
CHG Bathing Process

Monitor for compliance by assessing amount of CHG on the skin (Assay).

Prevent sub-optimal concentrations


*2% CHG cloth for bathing is consider an off label use of the product.

and always remember, my child...... only dead fish go with the flow.
For Successful Banning of Basins for Patient Care

- We need to provide alternatives for the other functions:

<table>
<thead>
<tr>
<th>Current</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emesis</td>
<td>Emebags being installed in every adult and ped pt. room, ACU, PACU</td>
</tr>
<tr>
<td>Storage of patient items</td>
<td>Clear plastic “baggies”</td>
</tr>
<tr>
<td></td>
<td>Trial of “Concierge List” to decrease waste of unused/unneeded products</td>
</tr>
<tr>
<td>Foot soaks</td>
<td>Shampoo caps, prepackaged</td>
</tr>
<tr>
<td>Shampoo patient’s hair</td>
<td>Shampoo caps par’d on all units</td>
</tr>
<tr>
<td>24 hour urine, ice</td>
<td>Store some basins in lab to be dispensed with each 24 hour jug.</td>
</tr>
<tr>
<td>Bath cloths with no insulation, cold halfway through bath.</td>
<td>Bath cloths with insulation to stay warm longer</td>
</tr>
</tbody>
</table>

Quinn B, et al. Presented at NACNS National Conference, March 5-7th, 2015, San Diego Ca
Source Control: The Oral Cavity as a Risk Factor in NV-HAP and VAP
Australian Pneumonia Data

Pneumonia refers to an infection of the lungs.

Around 17,900 hospital-acquired episodes of pneumonia occur each year in Australian hospitals.

The cost associated with Hospital Acquired Pneumonia in Australia

Could cost the hospital an additional $39,406

Patients with this Pneumonia require 19.0 extra days in the hospital compared to those who don’t have a Pneumonia.
VAP Data in the US

- VAP is associated with ↑ MV days and ↑ ICU & hospital LOS
- Attributable mortality estimated to be 4.0–13.5%
- Financial cost of a VAP episode has been estimated as approximately $20,000 to $40,000

Building Blocks to Best Practice in Caring for Mechanically Ventilated Patients

Ventilator Bundle: HOB 30, Deep Vein Thrombosis (DVT) prophylaxis, Peptic Ulcer Disease (PUD) prophylaxis, Sedation interruption, Spontaneous breathing trial, daily care with chlorhexidine

VAP Bundle: HOB 30, Sedation interruption, Spontaneous breathing trial, oral care 6x per day, CHG rinse 2x per day, subglottic secretions drainage if expected to be ventilated > 72hrs

http://www.ihi.org/resources/Pages/Tools/HowtoGuidePreventVAP.aspx
www.ICUliberation.org
Risk Factor Categories for Hospital Acquired Pneumonia

- Factors that increase bacterial burden or colonization
- Factors that increase risk of aspiration
Comprehensive Oral Care
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 VAPs 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
Dental Plaque Biofilms By Jill S. Nield-Gehrig, RDH, MA

This attachment structure requires mechanical removal with a good toothbrush.

Figure 7. The Pattern of Biofilm Development. The stages of biofilm maturation are: attachment, initial colonization, secondary colonization, and mature biofilm.
What Does the Evidence Tell Us?

- Brush
- CHG rinse alone
- CHG rinse in combination
- Swab/Clean/Moisturize
- Suction
- All of the above

Comprehensive Oral Care Program
Literature Review: Oral Care Impact of VAP

Comprehensive Oral Care:

• Reduction in VAP from 5.6 to 2.2 (Schleder B. et al. J Advocate Health 2002;4(1):27-30)

• Reduction in VAP from 4.10 (2005) to 2.15 (2006) with addition of CPC & comprehensive oral care. Vent bundle & rotational therapy already being performed

• Reduction in VAP from 12.0 to 8.0 (p=.060) with 80% compliance, vent bundle already being preformed, 1538 patients randomized to control or study group. Additional outcomes: ↓ vent days (p=.05), ↓ ICU LOS (p=.05), ↓ time to VAP (p= <.001), & reduction in mortality (p=.05) (Garcia R et al AJCC, 2009;18:523-534)
Literature Review: Oral Care Impact of VAP

Comprehensive Oral Care & CHG:

- Reduction in VAP to zero for 2 years, vent bundle, mobility, oral care & CHG with comprehensive education preformed (Murray TM et al. AACN Advanced Critical Care. 2007;18(2):190-199)

Dickinson S et al. SCCM Critical Connections, 02/2008
Type of Oral Care Impacted on VAP

- Multi-center prospective RCT (6 month trial)
- 1716 admitted to the ICUs; 219 fulfilled the criteria for inclusion and 213 were analyzed
- 108 were randomized to control group and 105 to intervention group (Tooth brushing with 0.12% CHG or 0.12% CHG alone q 12 hrs)
- Examine impact on VAP, time on vent & LOS

<table>
<thead>
<tr>
<th>Event</th>
<th>Control group (n = 108)</th>
<th>Intervention group (n = 105)</th>
<th>RR</th>
<th>CI (95%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>80 (47.6%)</td>
<td>88 (52.4%)</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yes</td>
<td>28 (62.2%)</td>
<td>17 (37.8%)</td>
<td>1.81</td>
<td>0.93 – 3.57</td>
<td>0.084</td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>81 (48.8%)</td>
<td>85 (51.2%)</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yes</td>
<td>27 (57.4%)</td>
<td>20 (42.6%)</td>
<td>1.41</td>
<td>0.73 – 2.70</td>
<td>0.296</td>
</tr>
<tr>
<td>Duration of mechanical ventilation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± sd</td>
<td>11.1 ± 7.6</td>
<td>8.7 ± 5.0</td>
<td>1.063</td>
<td>1.011 – 1.120</td>
<td>0.018*</td>
</tr>
<tr>
<td>Categorization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 5 days</td>
<td>13 (37.1%)</td>
<td>22 (62.9%)</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 to 10 days</td>
<td>40 (48.8%)</td>
<td>42 (41.2%)</td>
<td>1.61</td>
<td>0.71 – 3.70</td>
<td>0.249</td>
</tr>
<tr>
<td>11 days and more</td>
<td>28 (57.1%)</td>
<td>21 (42.9%)</td>
<td>2.27</td>
<td>0.93 – 5.55</td>
<td>0.073</td>
</tr>
<tr>
<td>Length of ICU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± sd</td>
<td>13.9 ± 8.6</td>
<td>11.9 ± 7.77</td>
<td>1.032</td>
<td>0.999 – 1.065</td>
<td>0.064</td>
</tr>
<tr>
<td>Categorization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 5 days</td>
<td>11 (39.3%)</td>
<td>17 (60.7%)</td>
<td>1.0</td>
<td>0.64 – 3.70</td>
<td>0.333</td>
</tr>
<tr>
<td>6 to 10 days</td>
<td></td>
<td></td>
<td></td>
<td>0.78 – 4.34</td>
<td>0.164</td>
</tr>
<tr>
<td>11 days and more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RR of Death 41% > in Control Group

Vidal CF, et. al. BMC Infectious Diseases (2017) 17:112
Risk Reduction of VAP with Oral Antisepsis: A Systematic Review & Meta-analysis

Villar CC, Respiratory Care, 2016 Sep;61(9):1245-59.

Impact of Oral CHG on Frequency of VAP

Villar CC, Respiratory Care, 2016 Sep; 61(9): 1245-59.
Does Compliance Make A Difference?

Oral care compliance & use of the ventilator bundle resulted in a 89.7% reduction in VAP.

Impact of a New Bundle/2 State Collaborative

- 38 hospitals, 56 ICU’s in 2 states from October 2012 to March 2015
- Evidence based interventions, teamwork & safety culture
- Head-of-bed elevation, use of subglottic secretion drainage endotracheal tubes, oral care, chlorhexidine mouth care, and daily spontaneous awakening and breathing trials.


- VAE: 7.34 to 4.58 cases per 1,000 ventilator-days (p = 0.007)
- IVAC 3.15 to 1.56 per 1,000 ventilator days (p = 0.018)
- PVAP 1.41 to 0.31 cases per 1,000 ventilator-days (p = 0.012)
TRUST THE PROCESS
Non-Vent Pneumonia: Addressing Risk Factors

Some slides courtesy of Barb Quinn
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</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 VAP excluded 30% of 838</td>
<td>30.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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>16.7 (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

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

HAPPI-2 Incidence of Non-Ventilator Hospital Acquired Pneumonia

- Multicenter retrospective chart review
- Extracted NV-HAP cases as per the 2014 ICD-9-CM codes for pneumonia not POA and the 2013 CDC case definition
- 21 hospitals completed data collection
- Measured nursing care missed 24hrs before diagnosis
- Non-vent HAP occurred on every unit

Baker D, Quinn B, Amer J of Infect Control, 2018;46:2-7
HAPPI-2 Incidence of Non-Ventilator Hospital Acquired Pneumonia

Missed nursing care 24 hours prior to Non-Vent HAP dx.

Baker D, Quinn B, Amer J of Infect Control, 2018;46:2-7
HAPPI-2 Incidence of Non-Vent Hospital Acquired Pneumonia

Results:
• 1300 NV-HAP (0.12-2.28 per 1000 pt days)
  – 18.4% mortality
  – 50% < 66 yrs old
  – 63% non-surgical
  – 70.8% outside the ICU
  – 27.3% in ICU
  – 18.8% transferred to ICU
  – 37.3% LOS >20 days
  – 57.7% LOS >15 days
  – 40.6% admitted from home were discharged back to home
  – 19.3% readmitted within 30 days
  – $36.4 - $52.56 million in extra costs

Med-Surg (43.1%; n = 560)
Telemetry (8.5%; n = 111)
Progressive (7.2%; n = 93)
Oncology (4.9%; n = 64)
Orthopedic (2.8%; n = 37)
Neurology (1.5%; n = 19)
Obstetric (0.2%; n = 3)
Epidemiology of Non-Ventilator Hospital Acquired Pneumonia in US

The 2012 US National Inpatient Sample dataset was used to compare an NV-HAP group to 4 additional group cohorts:
- pneumonia on admission
- general hospital admissions
- matched on mortality & disease severity
- ventilator-associated pneumonia (VAP)

Secondary outcome: compare HLOS, total hospital charges, and mortality between the NV-HAP group and the 4 I group cohorts.

Epidemiology of Non-Ventilator Hospital Acquired Pneumonia in US

- Incidence of NV-HAP was 1.6%, (3.63 per 1,000 pt days)
- NV-HAP was associated with:
  - Increased total hospital charges
  - Longer hospital length of stay
  - Greater likelihood of death

Compared to all groups except patients with VAP

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


Slide courtesy of Barb Quinn
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
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 $^{99}$Tc 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-hypopnea 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

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>[Mouth care]</td>
<td>[Ambulation]</td>
<td>[Patient assessment]</td>
</tr>
<tr>
<td></td>
<td>[Listening]</td>
<td>[Discharge planning]</td>
<td>[Surveillance]</td>
</tr>
<tr>
<td></td>
<td>[Being kept informed]</td>
<td>[Patient education]</td>
<td>[IV site care]</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>[Hand washing]</td>
</tr>
</tbody>
</table>

* IV, intravenous.
AACN Procedural Manual-7th ed

- Procedure 4: Endotracheal Tube Care and Oral Care
- Authors:
  - Kathleen M Vollman
  - Mary Lou Sole
  - Barbara Quinn
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).
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>

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

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

PRICELLESS

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
- Mandatory Education for Nurse Assistants

Number of non-ventilator HAP cases

[Graph showing data points and control limits with event markers]
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
Building Blocks to Best Practice in Caring for Mechanically Ventilated Patients

Ventilator Bundle: HOB 30, Deep Vein Thrombosis (DVT) prophylaxis, Peptic Ulcer Disease (PUD) prophylaxis, Sedation interruption, Spontaneous breathing trial, daily care with chlorhexidine

VAP Bundle: HOB 30, Sedation interruption, Spontaneous breathing trial, oral care 6x per day, CHG rinse 2x per day, subglottic secretions drainage if expected to be ventilated > 72hrs

ABCDE Bundle: Assess & manage pain, Both Spontaneous awakening trial (SAT) & spontaneous Breathing trial (SBT), Choice of Sedation, Delirium Assessment and management, Early Mobility, Family and Patient Engagement

http://www.ihi.org/resources/Pages/Tools/HowtoGuidePreventVAP.aspx
www.ICUliberation.org
ASSESS, PREVENT & MANAGE PAIN

BOTH SAT & SBT

CHOICE OF SEDATION

DELIRIUM

EARLY MOBILITY

FAMILY/PATIENT ENGAGEMENT

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

~ W. Edwards Deming
Bugging Out
Contact Kathleen Vollman at kvollman@comcast.net
www.Vollman.com

HAI prevention courses by Kathleen Vollman

https://www.medbridgeeducation.com/certificate_programs/20336-healthcare-acquired-infections-prevention-is-key