Horizontal vs. Vertical Approach to Infection Prevention: Practical Strategies to Reduce HAIs

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Disclosures

- Hill-Rom Speaker Bureau & Consultant
- Eloquest Healthcare Speaker Bureau & Consultant
- Sage Products Speaker Bureau & Consultant
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</td>
<td>1 out of 25 (4%)</td>
</tr>
<tr>
<td>develop infection:</td>
<td></td>
</tr>
<tr>
<td>Death due to</td>
<td>700/day</td>
</tr>
<tr>
<td>sepsis/septic shock:</td>
<td></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>


HAI Progress Report

- 50% decrease in CLABSI between 2008 and 2014
- No change in overall CAUTI between 2009 and 2014
- Progress in non-ICU settings between 2009 and 2014, in all settings between 2013 and 2014, and even more progress in all settings toward the end of 2014
- 13% reduction in MRSA bactermia’s
- 17% decrease in SSI related to the 10 select procedures tracked in previous reports. Between 2008 and 2014:
  - 17% decrease in abdominal hysterectomy SSI
  - 2% decrease in colon surgery SSI

Health Care Associated Infection Data

<table>
<thead>
<tr>
<th>Measurement</th>
<th>NHSN 2013 3815 Acute Care Hospitals</th>
<th>INICC 43 Countries 2007-2012</th>
<th>Single Center Private Hospital South Africa from 2012-2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAP/per 1000 vent days</td>
<td>Range of pooled means 0.2 (Ped CVICU) -4.4 (Burn ICU)</td>
<td>Range of pooled means 7.9 (Peds) – 29.6 (Trauma)</td>
<td>From 11.29 to 6.53 per 1000 vent day</td>
</tr>
<tr>
<td>CLA-BSI/per 1000 cath days</td>
<td>Range of pooled means 0.0 (Prenatal )-2.9 (Burn ICU)</td>
<td>Range of pooled means 1.02 (Surg Cardio)- 6.38 (Neuro)</td>
<td>From 2.15 to 0.0 per 1000 cath days</td>
</tr>
<tr>
<td>CA-UTI/per 1000 cath days</td>
<td>Range of pooled means 0.0 (Peds Surgical)-4.8 (Burns) Stepdown 0.8 (Peds) – 1.7 (Adults)</td>
<td>Range of pooled means 1.29 (Surg Cardio) – 15.99 (Neuro)</td>
<td>Range from 0 to 3.73 per 1000 cath days</td>
</tr>
</tbody>
</table>


Economic Burden of HAIs: Build the Business Case

- Generated point estimates for attributable cost & LOS
- 5 Major Infections = 9.8 billion
  - SSI, CLABSI, VAP/VAE, CAUTI, C-Diff
- SSI (33.7%)
- VAP (31.6%)
- CLABSI (18.9%)
- C-Diff (15.4%)
- CAUTI (<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>

Building Resiliency Into Interventions

Forcing Functions and Constraints
- Automation and Computerization
- Standardization and Protocols
- Checklist and Independent Check Systems
- Rules and Policies
- Education and Information
- Vague Warning – “Be More Careful”

Strongest

STRENGTH OF INTERVENTION

Weakest

Common Routes of Transmission


Isolation Room Surfaces

1. Exposure
- Known Infection or Colonization
- Portable Equipment
- Hands of Healthcare Personnel
- Susceptible Patient

2. Unidentified Carrier
- Skin, Bedding, and Clothing

3. Skin, Bedding, and Clothing

4. Unidentified Carrier

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

- **Implement a MRSA monitoring program** (III)
  - IP strategy application
  - Tracking hospital onset
  - Alert system for + new admit or readmission

- **Hand hygiene** (II)

- **Contact precautions** for MRSA colonized & MRSA infected patients (II)
  - Isolation demonstrated hypo & hyper glycemic, MDRO-VAP, errors with anticoagulant meds, anxiety and greater patient dissatisfaction.

- **Decontamination of environment and equipment** (II)

- **Decontamination of the patient-universal decolonization**

- **Practice the device bundles** (VAP, BSI, UTI)

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Active Surveillance-When

- Prior to surgical procedures to determine carriage or active infection
- Use AST - Active surveillance testing
- Based on locations or populations of patients with unacceptably high rates of MDRO despite basics MDRO transmission prevention strategies in place
- AST of healthcare workers an unresolved issue


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Hand Hygiene is the Single Most Important Factor in Preventing the Spread of Infection

Adherence remains low 30-60%
Guidelines for Hand Hygiene in Health Care Settings

- If hands are not visibly soiled, use an alcohol-based hand rub 62% for routinely decontaminating hands in all other clinical situations (20-30 seconds) (II)
- When hands visibly soiled or exposure to potential spore forming organisms, wash with either a non-antimicrobial or antimicrobial soap & water (40-60 seconds) (II)
- Do not use Triclosan containing soaps
- Decontaminate hands after removing gloves
- Provide HCW with hand lotions & creams to minimize occurrence of irritant contact dermatitis
- Use multidimensional strategies to improve hand hygiene practice (IA)
- Do not wear artificial fingernails or extenders

CDC. Hand Hygiene Guidelines: MMWR 2002; 51(No. RR-16):[1-45]
WHO Hand Hygiene Guidelines 2009

Reasons for Non-Compliance

- Inconvenient location of sinks and dispenser
- **Lack of understanding of correct technique**
- Understaffing and overcrowding
- Cultural issues
- Poor access
- **Irritant contact dermatitis associated with frequent exposure**
- Lack of institutional commitment to good hand hygiene

WHO Hand Hygiene Guidelines 2009
Correct use can reduce colony forming units by 90%, incorrect use only 60%. 1-3mL correct amount per HH episode

When to Wash

My 5 moments for HAND HYGIENE

Similar rates of HH compliance
Sunkesula VCK, et al AJIC, 2015;43:16019

Printz D. Infect Control Hosp Epidemiol, 2009;30(7):611-622
WHO Hand Hygiene Guidelines 2009
Key Components to Multimodal Strategy to Improve Adherence (II)

- Education & motivation & strong commitment to improve hand hygiene by frontline workers & leadership (Institutional safety climate)
- Engage staff in the process
- Simply & standardize
- Alcohol-based hand rub as primary method for hand hygiene….right product
- C-diff-wear gloves & gown/both methods of hand hygiene are not real effective
- Verified by competency, monitored compliance and feedback/weekly initially (II)

WHO Guidelines 2009
Pittet D. Infect Control & Hosp Epidemio, 2008;29:957-959
Sax, H., et. al. Infection Control and Hospital Epidemiology 2009, 28, 1267-1274
Erasmus, V. et. Infection Control and Hospital Epidemiology/2009 30(5), 415-419
Bonnet N. et al. Critical Care Nursing Quarterly, 2009;32:144-148

Hand Hygiene Measurement Methods

- Direct Observation
- Product Usage/Volume
- Automation monitoring can improve compliance
  - Electronic versus direct observation accurate in measuring compliance

Increase use of alcohol hand rub (measure by volume use) correlated significantly (p=0.014) with improvement in MRSA rates

Morgan DJ, et al. AJIC, 2012-40:955
Haas and Larson Journal of Hospital Infection 2007;66:6-14
Reducing MDRO's

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Organizations Journey of Discontinuing Contact Precautions for MRSA & VRE

- 865-bed, safety-net, academic medical center.
- Quasi-experimental, before-and-after study (30 months)
- Discontinuing CPs for MRSA or VRE colonized/infected patients
- During intervention period: hand hygiene, daily chlorhexidine bathing of all inpatients (except infants) & bare below the elbows protocol for inpatient care.

The Environment

Substantial scientific evidence has accumulated that contamination of environmental surfaces in hospital rooms plays an important role in the transmission of several key health care–associated pathogens

Weber DJ, AJIC, 2016;44:77-84

The Story

- The pathogen is capable of surviving on surfaces & equipment for a prolonged time.
- Contact with room surfaces or equipment by HCP frequently leads to contamination of hands or gloves.
- The frequency with which room surfaces are contaminated correlates with the frequency of hand or glove contamination of HCP.
- The patient admitted to a room previously occupied by a patient colonized or infected with a pathogen has an increased likelihood of developing colonization or infection with that pathogen.
- Improved terminal cleaning of rooms leads to a decreased rate of individual patient colonization and infection & facility-wide rate of colonization and infection.

Weber DJ, AJIC, 2016;44:77-84
Application of Recommendations for Environmental Cleaning

- Resources to ensure effective cleaning and decontamination
  - Use of a check list
  - Clean equipment that is transported from room to room
  - Dedicated equipment in isolation rooms
  - Reduce load—adequate time to clean
  - Education of healthcare workers and support staff
- Daily disinfection of non-critical surfaces vs. just visibly soiled
- Feedback method using removal of intentional applied marks visible only under UV light
- Wipes that keep the surface wet for 1-2 minutes
- Reusable cloths changed with each room clean and use 3 per room

Weber DJ, AJIC, 2016;44:77-84

Improving Environmental Hygiene In 27 ICUs Decreased MDRO Transmission

- 27 acute care hospitals (25 beds to 709 beds)
- Fluorescent targeting method used to objectively evaluate the thoroughness of terminal room cleaning before and after a structured educational, procedural and administrative interventions
- Systematic covert monitoring was performed

Results:
- 3532 environmental surfaces were assessed after terminal cleaning in 260 ICU unit rooms
- 49.5% of services cleaned at baseline
- Post-intervention with multiple cycles of objective performance feedback resulted in 82% of environmental services cleaned (p < .0001)

No Touch Cleaning

• Use of a no touch method leads to a decreased rate of infection in patients subsequently admitted to a room where the prior occupant was colonized or infected.
• Use of a no touch method leads to a decreased rate of facility-wide colonization and infection.
• Hydrogen peroxide vapor & aerosolized significantly reduce MDRO load in terminal cleaning. (vapor: 1.5 to 2.5hrs, aerosolized: 2-3hrs)
  – Aerosolized not well studied versus vapor
  – Contaminated surfaces reduced to 0% to <5%
• Ultraviolet–C to kill pathogens.
  – 10-45 minutes of use, C. difficile spores
  – 10-25 minutes for non-spore forming bacteria
  – Contaminated surfaces reduced <1% to <11%

Reducing the Load in the Environment: Additional Factors

• Hospital curtains potential source of transmission
  – Novel curtains increase time to first contamination (7x longer)
• Daily cleaning of high touch surfaces
• Disinfecting surfaces (copper/silver coating)
• ECG disposable or reusable
  – Cluster-randomized controlled design
  – Match ICU’s randomized to get disposable or reusable ECG
  – Measured infection rates

Reducing MDRO's

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- Decontamination of the patient-universal decolonization

- Practice the device bundles (VAP,BSI, UTI)

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Reducing Bacterial Load on the Patient: A Horizontal Strategy

Evidence Based Bathing Practices
Patients At Risk

Multi-Drug Resistant Organisms
- Immunodeficiencies
- Breaks in skin integrity related to invasive devices
- Co-morbidities
- Hand transmission
- Equipment contamination/Hospital environment

Damage the Natural Barriers to Infection...the Skin
- Bathing techniques
- Soaps
- Wash cloths

Optimal Hygiene
- pH balanced (4-6.8)
  - Stable pH discourages colonization of bacteria & ↓ risk of infection
  - Bar soaps may harbor pathogenic bacteria
- Excessive washing/use of soap compromises the water holding capacity of the skin
- Non-drying, lotion applied
- Multiple steps can lead to large process variation

References:
Bonten MJM. Am J Respir Crit Care Med. 2011;184:991-993
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

- Contaminated: 62% (686 basins/88 hospitals)
- Gram negative bacilli: 45% (495 basins/86 hospitals)
- Colonized w/ VRE: 35% (385 basins/80 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


Waterborne Infection

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

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

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

Veron MO et al. Archives Internal Med 2006;166:306-312
Impact on VRE with 2% CHG Cloth Bathing*

Veron MO et al. Archives Internal Med 2006;166:306-312

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

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The Efficacy of Daily Bathing with Chlorhexidine for Reducing Healthcare-Associated Bloodstream Infections: A Meta-analysis

John C. O’Hero, MD, MB, R. Guerino L. M. Silva, MD, L. Silvio Munoz-Price, MD, N. Nisius Soldier, MD, PhD

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<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Events</th>
<th>Control Events</th>
<th>Total Events</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
<th>Odds Ratio M-I, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2.1 CHG Bathing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone et al., 2007</td>
<td>2</td>
<td>35</td>
<td>37</td>
<td>0.16 (0.04, 0.70)</td>
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</tr>
<tr>
<td>Csety et al., 2003</td>
<td>1</td>
<td>15</td>
<td>16</td>
<td>0.89 (0.36, 2.21)</td>
<td></td>
</tr>
<tr>
<td>Climo et al., 2009</td>
<td>18</td>
<td>137</td>
<td>155</td>
<td>0.37 (0.24, 0.61)</td>
<td></td>
</tr>
<tr>
<td>Gould et al., 2007</td>
<td>129</td>
<td>204</td>
<td>333</td>
<td>0.37 (0.24, 0.57)</td>
<td></td>
</tr>
<tr>
<td>Munoz-Price et al., 2000</td>
<td>79</td>
<td>202</td>
<td>281</td>
<td>0.39 (0.28, 0.55)</td>
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</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>531</td>
<td>729</td>
<td>1260</td>
<td>0.39 (0.28, 0.55)</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>728</td>
<td></td>
<td>936</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau^2 = 0.12; CHI^2 = 13.07, df = 6 (P = 0.03); I^2 = 64%
Test for overall effect: Z = 3.33 (P = 0.0004)

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L2.2 CHG Impregnated Cloths

Brenneman et al., 2007 | 20 | 2210 | 2430 | 0.93 (0.88, 0.99) |
Debnam and Conway, 2010 | 4 | 1364 | 1408 | 1.09 (0.94, 1.28) |
Everts et al., 2009 | 7 | 2716 | 2847 | 1.09 (0.94, 1.28) |
Hooder and Delinger, 2009 | 2 | 2000 | 2233 | 1.10 (0.96, 1.24) |
Montgomery et al., 2010 | 27 | 13864 | 14103 | 0.99 (0.93, 1.05) |
Pappas et al., 2009 | 2 | 5616 | 5679 | 1.00 (0.95, 1.06) |
Rappaport et al., 2005 | 17 | 1795 | 1914 | 1.02 (0.95, 1.09) |
Subtotal (95% CI) | 95 | 5412 | 5507 | 1.01 (0.95, 1.07) |
Total events | 123 | 1771 |
Heterogeneity: Tau^2 = 0.09; CHI^2 = 12.36, df = 6 (P = 0.01); I^2 = 53%
Test for overall effect: Z = 3.78 (P = 0.002)

Total (95% CI) | 67775 | 69637 | 100.00% | 0.44 (0.33, 0.59) |

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

Infect Control Hosp Epidemiol 2012;33(3):257-267
2% CHG Cloth Bathing: SCRUB Trial Critically Ill Children

- Cluster-randomized 2-period cross over trial
- >2 months of age
- 6 month
- 4947 admissions
  - SOC: basin less bathing or soap & H₂O
  - CHG: 2% CHG cloth
- Demographics similar
- Outcomes:
  - Primary bacteremia-36% reduction
  - 12 pts withdrew because of skin irritations (1%)
  - CHG-associated skin reactions-1-2 per 1000 pt days

**Daily Bathing**

<table>
<thead>
<tr>
<th>SOC</th>
<th>4.93</th>
</tr>
</thead>
<tbody>
<tr>
<td>2% CHG</td>
<td>3.28</td>
</tr>
</tbody>
</table>

36% Reduction


The Evidence: Impact of 2% CHG Cloth Baths*
Evaluate effect of daily bathing with CHG on acquisition of MDRO’s and incidence of CLABSI

9 ICU’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

<table>
<thead>
<tr>
<th>MDROs</th>
<th>HAIs (primary blood streams)</th>
<th>Gram positive</th>
<th>Fungal</th>
</tr>
</thead>
<tbody>
<tr>
<td>23% reduction</td>
<td>28% reduction</td>
<td>50% reduction</td>
<td>90% reduction</td>
</tr>
</tbody>
</table>

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

Results: No Swab Group
Universal Decolonization Demonstrated

37% reduction
44% reduction

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


CHG Bathing: Meta-Analysis

- Meta-analysis performed using Cochrane Collaboration methodology
- 18 studies included
- Examine risk of acquiring HAI: CLA-BSI, MRSA, VRE
- Longer duration & nasal antibiotic showed even lower risk MRSA

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Impact of 2% CHG Cloth Bath*: Follow Up Analysis On Universal Decolonization on Bacteriuria & Candiduria

3 protocols tested:
a) Swab for MRSA on admission to ICU
   - Isolate if positive
b) Swab for MRSA on admission to ICU
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   - Nasal mucopiricin x 5 days
   - 2% CHG cloth* bathing for entire ICU stay
c) No swab
   - Nasal mucopiricin x 5 days
   - 2% CHG cloth bath* for entire ICU stay

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

- Demonstrates lower rates of blood culture contamination with universal decolonization with CHG cloth bathing* (Septimus EJ, et al. Infect Control Hosp Epidemiol, 2014;35:S17-22)


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

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### CHG Bathing Process

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

**Prevent sub-optimal concentrations**


Cleansing of Patients with Indwelling Catheter

- Indwelling catheter care should occur with the daily bath (basinless bathing)*, as a separate procedure using clean technique
- There is no evidence to support 2x a day indwelling catheter care
- If a large liquid stool occurs, bathe the patient with basin less bathing
- Use separate cloths to clean front to back in the perineal area and 6 inches of the catheter**
- Apply barrier cloth to area of skin requiring protection


Bugs Be Gone!!!!

Putting it Together
Horizontal Approach: It Works

- Retrospective, observational study in the surgical ICU of a tertiary care medical center in Boston, MA, from 2005 to 2012
- N=6,697 patients in the surgical ICU

↓21% per year since 2008
Zero MRSA infections

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

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Forbid yourself to be deterred by poor odds just because your mind has calculated that the opposition is too great. If it were easy, everyone would do it.

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