XII SIMPOSIO INTERNACIONAL EN RESISTENCIA BACTERIANA "DIAGNOSTIC STEWARDSHIP" Y CONTROL DE LAS INFECCIONES

Febrero 24 al 26 de 2021
Best Practices in Disinfection of Noncritical Surfaces in the Healthcare Setting: A Bundle Approach

Skin Antisepsis: CHG Treatment and Skin Site Prep

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Former Director, Hospital Epidemiology, Occupational Health and Safety, UNC Health Care, Chapel Hill, NC (1979-2017)
• Consultations
  ■ PDI (Professional Disposable International)

• Honoraria
  ■ PDI

• Acknowledgement: Some CHG slides from Dr. Emily E. Sickbert-Bennett, Ms. Shelley Summerlin-Long
Sources of Healthcare-Associated Pathogens

• Endogenous flora (SSI, UTI, CLABSI): 40-60%
• Exogenous: 20-40% (e.g., cross-infection via contaminated hands [staff, visitors])
• Other (environment): 20%
  ■ Medical devices
  ■ Contact with environmental surfaces (direct and indirect contact)
Our Responsibility to the Future

Institute Practices that Prevent All Infectious Disease Transmission via Environment
Environmental Contamination Leads to HAIs


- Evidence environment contributes
- Role-MRSA, VRE, C. difficile
- Surfaces are contaminated ~25%
- EIP survive days, weeks, months
- Contact with surfaces results in hand contamination
- Disinfection reduces contamination
- Disinfection (daily) reduces HAIs
- Rooms not adequately cleaned
Admission to Room Previously Occupied by Patient C/I with Epidemiologically Important Pathogen

- Results in the newly admitted patient having an increased risk of acquiring that pathogen by 39-353%
- For example, increased risk for *C. difficile* is 235% (11.0% vs 4.6%)
- Exposure to contaminated rooms confers a 5-6 fold increase in odds of infection, hospitals must adopt proven methods for reducing environmental contamination (Cohen et al. ICHE. 2018;39:541-546)
Acquisition of EIP on Hands of Healthcare Providers after Contact with Contaminated Environmental Sites and Transfer to Other Patients
Acquisition of EIP on Hands of Patient after Contact with Contaminated Environmental Sites and Transfers EIP to Eyes/Nose/Mouth
Best Practices in Disinfection of Noncritical Surfaces in the Healthcare Setting: A Bundle Approach

A set of evidence-based practices, generally 3-5, that when performed collectively and reliably have been proven to improve patient outcomes
A Bundle Approach to Surface Disinfection

- Develop policies and procedures
- Select cleaning and disinfecting products
- Educate staff-environmental services and nursing
- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance
KEY PATHOGENS WHERE ENVIRONMENTIAL SURFACES PLAY A ROLE IN TRANSMISSION

- MRSA
- VRE
- *Acinetobacter* spp.
- *Clostridium difficile*
- Norovirus
- Rotavirus
- SARS
## ENVIRONMENTAL CONTAMINATION
### ENDEMIC AND EPIDEMIC MRSA

<table>
<thead>
<tr>
<th>Site</th>
<th>Outbreak</th>
<th>Endemic</th>
<th>Site estimated means</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Floor</strong></td>
<td>9%</td>
<td>50-55%</td>
<td>34.5%</td>
</tr>
<tr>
<td><strong>Bed linen</strong></td>
<td>..</td>
<td>38-54%</td>
<td>41%</td>
</tr>
<tr>
<td><strong>Patient gown</strong></td>
<td>..</td>
<td>40-53%</td>
<td>40.5%</td>
</tr>
<tr>
<td><strong>Overbed table</strong></td>
<td>..</td>
<td>18-42%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Blood pressure cuff</strong></td>
<td>13%</td>
<td>25-33%</td>
<td>21%</td>
</tr>
<tr>
<td><strong>Bed or siderails</strong></td>
<td>5%</td>
<td>1-30%</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Bathroom door handle</strong></td>
<td>..</td>
<td>8-24%</td>
<td>14%</td>
</tr>
<tr>
<td><strong>Infusion pump button</strong></td>
<td>13%</td>
<td>7-18%</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Room door handle</strong></td>
<td>11%</td>
<td>4-8%</td>
<td>21.5%</td>
</tr>
<tr>
<td><strong>Furniture</strong></td>
<td>11%</td>
<td>44-59%</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Flat surfaces</strong></td>
<td>7%</td>
<td>32-38%</td>
<td>21.5%</td>
</tr>
<tr>
<td><strong>Sink taps or basin fitting</strong></td>
<td>..</td>
<td>14%</td>
<td>23.5%</td>
</tr>
</tbody>
</table>

Average quoted*: 11% 27% 49% 25% 74% 37%

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Survival Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. aureus (including MRSA)</td>
<td>7 days to &gt;12 months</td>
</tr>
<tr>
<td>Enterococcus spp. (including VRE)</td>
<td>5 days to &gt;46 months</td>
</tr>
<tr>
<td>Acinetobacter spp.</td>
<td>3 days to 11 months</td>
</tr>
<tr>
<td>Clostridium difficile (spores)</td>
<td>&gt;5 months</td>
</tr>
<tr>
<td>Norovirus (and feline calicivirus)</td>
<td>8 hours to &gt;2 weeks</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>6 hours to 16 months</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>2 hours to &gt;30 months</td>
</tr>
</tbody>
</table>

FREQUENCY OF ACQUISITION OF MRSA ON GLOVED HANDS AFTER CONTACT WITH SKIN AND ENVIRONMENTAL SITES

No significant difference on contamination rates of gloved hands after contact with skin or environmental surfaces (40% vs 45%; p=0.59)

Major article

Does improving surface cleaning and disinfection reduce health care-associated infections?

Curtis J. Donskey MD a, b, *  

a Geriatric Research, Education, and Clinical Center, Cleveland Veterans Affairs Medical Center, Cleveland, OH  
b Case Western Reserve University School of Medicine, Cleveland, OH

Contaminated environmental surfaces provide an important potential source for transmission of health care-associated pathogens. In recent years, a variety of interventions have been shown to be effective in improving cleaning and disinfection of surfaces. This review examines the evidence that improving environmental disinfection can reduce health care-associated infections.

Key Words: Environment Cleaning Transmission

Contaminated environmental surfaces provide an important potential source for transmission of many health care associated pathogens. These include Gram-negative and Gram-positive bacteria, as well as fungal pathogens. Pathogens shed organisms onto their skin, clothing, bedding, and nearby environmental surfaces. In addition to surfaces in rooms, portable equipment used in patient care can also be a source of transmission.
Environmental Disinfection Interventions

Donskey CJ. Am J Infect Control 2013;41:S12

- Cleaning product substitutions
- Improvements in the effectiveness of cleaning and disinfection practices
  - Education
  - Audit and feedback
  - Addition of housekeeping personnel or specialized cleaning staff
- Automated technologies
- Conclusion: Improvements in environmental disinfection may prevent transmission of pathogens and reduce HAIs
ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

- There is increasing evidence to support the contribution of the environment to disease transmission
- This supports comprehensive disinfecting regimens (goal is not sterilization) to reduce the risk of acquiring a pathogen from the healthcare environment/equipment
Disinfection of Noncritical Surfaces Bundle
NL Havill AJIC 2013;41:S26-30

- Develop policies and procedures
- Select cleaning and disinfecting products
- Educate staff-environmental services and nursing
- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance
Disinfection of Noncritical Surfaces Bundle

• Develop policies and procedures
  ■ Standardize C/D patient rooms and pieces of equipment throughout the hospital
  ■ All touchable hand contact surfaces wiped with disinfection daily, when spills occur and when the surfaces are visibly soiled.
  ■ All noncritical medical devices should be disinfected daily and when soiled
  ■ Clean and disinfectant sink and toilet
  ■ Damp mop floor with disinfectant-detergent
  ■ If disinfectant prepared on-site, document correct concentration
  ■ Address treatment time/contact time for wipes and liquid disinfectants (e.g., treatment time for wipes is the kill time and includes a wet time via wiping as well as the undisturbed time).
REVIEW THE “BEST” PRACTICES FOR CLEANING AND DISINFECTING

Cleaning and disinfecting is one-step with disinfectant-detergent. No pre-cleaning necessary unless spill or gross contamination. In many cases “best” practices not scientifically determined.
Blood Pressure Cuff
Non-Critical Patient Care Item
Surface Disinfection
Noncritical Patient Care

• Disinfecting Noncritical Patient-Care Items
  ▶ Process noncritical patient-care equipment with an EPA-registered disinfectant at the proper use dilution and a contact time of at least 1 min. Category IB
  ▶ Ensure that the frequency for disinfecting noncritical patient-care surfaces be done minimally when visibly soiled and on a regular basis (such as after each patient use or once daily or once weekly). Category IB
Surface Disinfection
Environmental Surfaces

• Disinfecting Environmental Surfaces in HCF
  - Disinfect (or clean) housekeeping surfaces (e.g., floors, tabletops) on a regular basis (e.g., daily, three times per week), when spills occur, and when these surfaces are visibly soiled. Category IB
  - Use disinfectant for housekeeping purposes where: uncertainty exists as to the nature of the soil on the surfaces (blood vs dirt); or where uncertainty exists regarding the presence of multi-drug resistant organisms on such surfaces. Category II
It appears that not only is disinfectant use important but how often is important.

Daily disinfection vs clean when soiled
Daily disinfection of high-touch surfaces (vs cleaned when soiled) with sporicidal disinfectant (PA) in rooms of patients with CDI and MRSA reduced acquisition of pathogens on hands after contact with surfaces and of hands caring for the patient. Daily disinfection less hand contamination.
Use of a Daily Disinfectant Cleaner Instead of a Daily Cleaner Reduced HAI Rates
Alfa et al. AJIC 2015.43:141-146

- Method: Improved hydrogen peroxide disposable wipe was used once per day for all high-touch surfaces to replace cleaner.
- Result: When cleaning compliance was ≥ 80%, there was a significant reduction in cases/10,000 patient days for MRSA, VRE and C. difficile.
- Conclusion: Daily use of disinfectant applied to environmental surfaces with a 80% compliance was superior to a cleaner because it resulted in significantly reduced rates of HAIs caused by C. difficile, MRSA, VRE.
EVIDENCE THAT ALL TOUCHABLE ROOM SURFACES ARE EQUALLY CONTAMINATED

<table>
<thead>
<tr>
<th>Surface (no. of samples)</th>
<th>Precleaning</th>
<th>Postcleaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (n = 40)</td>
<td>71.9 (46.5–97.3)</td>
<td>9.6 (3.8–15.4)</td>
</tr>
<tr>
<td>Medium (n = 42)</td>
<td>44.2 (28.1–60.2)</td>
<td>9.3 (1.2–17.5)</td>
</tr>
<tr>
<td>Low (n = 37)</td>
<td>56.7 (34.2–79.2)</td>
<td>5.7 (2.01–9.4)</td>
</tr>
</tbody>
</table>

Note. CFU, colony-forming unit; CI, confidence interval.


ALL “TOUCHABLE” (HAND CONTACT) SURFACES SHOULD BE WIPED WITH DISINFECTANT

“High touch” objects only recently defined (no significant differences in microbial contamination of different surfaces) and “high risk” objects not epidemiologically defined. Cleaning and disinfecting is one-step with disinfectant-detergent. No pre-cleaning necessary unless spill or gross contamination.
Effective disinfection of contaminated surfaces is essential to prevent transmission of epidemiologically-important pathogens.

Efforts to improve disinfection focuses on touched surfaces.

Although floors contaminated, limited attention because not frequently touched.

Floors are a potential source of transmission because often contacted by objects that are then touched by hands (e.g., shoes, socks).

Non-slip socks contaminated with MRSA, VRE (Mahida, J Hosp Infect. 2016;94:273).
### Recovery of Nonpathogenic Viruses from Surfaces and Patients on Days 1, 2, and 3 After Inoculation of Floor Near Bed

Koganti et al. ICHE 2016. 37:1374

<table>
<thead>
<tr>
<th>Variable</th>
<th>Day 1 (% Positive)</th>
<th>Day 2 (% Positive)</th>
<th>Day 3 (% Positive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Hands</td>
<td>40</td>
<td>63</td>
<td>43</td>
</tr>
<tr>
<td>Patient Footwear</td>
<td>100</td>
<td>100</td>
<td>86</td>
</tr>
<tr>
<td>High-touch surface &lt;3ft</td>
<td>58</td>
<td>62</td>
<td>77</td>
</tr>
<tr>
<td>High-touch surface &gt;3ft</td>
<td>40</td>
<td>68</td>
<td>34</td>
</tr>
<tr>
<td>Personal items</td>
<td>50</td>
<td>44</td>
<td>50</td>
</tr>
<tr>
<td>Adjacent room floor</td>
<td>NA</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>Adjacent room environment</td>
<td>NA</td>
<td>40</td>
<td>11</td>
</tr>
<tr>
<td>Nursing station</td>
<td>53</td>
<td>47</td>
<td>63</td>
</tr>
<tr>
<td>Portable equipment</td>
<td>33</td>
<td>23</td>
<td>100</td>
</tr>
</tbody>
</table>

Surfaces <3ft included bedrail, call button, telephone, tray table, etc; surfaces >3ft included side table, chair, IV pole, etc; personal-cell phones, books, clothing, wheelchairs; nurses station included computer keyboard, mouse, etc
Found that a nonpathogenic virus inoculated onto floors in hospital rooms disseminated rapidly to the footwear and hands of patients and to high-touch surfaces in the room.

The virus was also frequently found on high-touch surfaces in adjacent rooms and nursing stations.

Contamination in adjacent rooms in the nursing station suggest HCP contributed to dissemination after acquiring the virus during contact with surfaces or patients.

Studies needed to determine if floors are source of transmission.
Disinfection of Noncritical Surfaces Bundle

- Develop policies and procedures
- Select cleaning and disinfecting products
- Educate staff-environmental services and nursing
- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance
THE “BEST” PRACTICES FOR CLEANING AND DISINFECTING

Cleaning and disinfecting is one-step with disinfectant-detergent. No pre-cleaning necessary unless spill or gross contamination. In many cases “best” practices not scientifically determined.
• Cleaning-removes organisms/organic matter
• Disinfection-inactivates organisms
## Effectiveness of Different Methods of Surface Disinfection for MRSA


<table>
<thead>
<tr>
<th>Technique (with cotton)</th>
<th>MRSA Log$_{10}$ Reduction (QUAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturated cloth</td>
<td>4.41</td>
</tr>
<tr>
<td>Spray (10s) and wipe</td>
<td>4.41</td>
</tr>
<tr>
<td>Spray, wipe, spray (1m), wipe</td>
<td>4.41</td>
</tr>
<tr>
<td>Spray</td>
<td>4.41</td>
</tr>
<tr>
<td>Spray, wipe, spray (until dry)</td>
<td>4.41</td>
</tr>
<tr>
<td>Disposable wipe with QUAT</td>
<td>4.55</td>
</tr>
<tr>
<td>Control: detergent</td>
<td>2.88</td>
</tr>
</tbody>
</table>
Effective Surface Decontamination

Product and Practice = Perfection
Effective Surface Decontamination

Product and Practice = Perfection
PROPERTIES OF AN IDEAL DISINFECTANT


- Broad spectrum-wide antimicrobial spectrum
- Fast acting-should produce a rapid kill
- Remains Wet-meet listed kill/contact times with a single application
- Not affected by environmental factors-active in the presence of organic matter
- Nontoxic-not irritating to user
- Surface compatibility-should not corrode instruments and metallic surfaces
- Persistence-should have sustained antimicrobial activity
- Easy to use
- Acceptable odor
- Economical-cost should not be prohibitively high
- Soluble (in water) and stable (in concentrate and use dilution)
- Cleaner (good cleaning properties) and nonflammable
Environmental Disinfection Interventions
Donskey CJ. Am J Infect Control 2013;41:S12

- Cleaning product substitutions
- Improvements in the effectiveness of cleaning and disinfection practices
  - Education
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  - Addition of housekeeping personnel or specialized cleaning staff
- Automated technologies
- Conclusion: Improvements in environmental disinfection may prevent transmission of pathogens and reduce HAIs
Most prevalent pathogens causing HAI (easy to kill)
- *E. coli* (15.4%)
- *S. aureus* (11.8%)
- *Klebsiella* (7.7%)
- Coag neg Staph (7.7%)
- *E. faecalis* (7.4%)
- *P. aeruginosa* (7.3%)
- *C. albicans* (6.7%)
- *Enterobacter* sp. (4.2%)
- *E. faecium* (3.7%)

Common causes of outbreaks and ward closures (relatively hard to kill)
- *C. difficile* spores
- Norovirus
- Rotavirus
- Adenovirus
Microbiological Disinfectant Hierarchy
Rutala WA, Weber DJ, HICPAC. www.cdc.gov

Most Susceptible

Enveloped Viruses (HIV, HSV, Flu)

Bacteria (MRSA, VRE, Acinetobacter)

Fungi (Candida, Trichophyton)

Non-Enveloped Viruses (norovirus, HAV, polio)

Mycobacteria (M. tuberculosis)

Spores (C. difficile)

Most Resistant

LLD
## LOW-LEVEL DISINFECTION FOR NONCRITICAL EQUIPMENT AND SURFACES


<table>
<thead>
<tr>
<th>Germicide</th>
<th>Use Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl or isopropyl alcohol</td>
<td>70-90%</td>
</tr>
<tr>
<td>Chlorine</td>
<td>100ppm (1:500 dilution)</td>
</tr>
<tr>
<td>Phenolic</td>
<td>UD</td>
</tr>
<tr>
<td>Iodophor</td>
<td>UD</td>
</tr>
<tr>
<td>Quaternary ammonium (QUAT)</td>
<td>UD</td>
</tr>
<tr>
<td>QUAT with alcohol</td>
<td>RTU</td>
</tr>
<tr>
<td>Improved hydrogen peroxide (HP)</td>
<td>0.5%, 1.4%</td>
</tr>
<tr>
<td>PA with HP, HP, chlorine (C. difficile)</td>
<td>UD</td>
</tr>
</tbody>
</table>

**Note:**
- UD=Manufacturer’s recommended use dilution; others in development/testing-electrolyzed water; polymeric guanidine; cold-air atmospheric pressure plasma (Boyce Antimicrob Res IC 2016. 5:10)
C. difficile
EPA-Registered Products

- List K: EPA’s Registered Antimicrobials Products Effective Against *C. difficile* spores, April 2014
- [http://www.epa.gov/oppad001/list_k_clostridium.pdf](http://www.epa.gov/oppad001/list_k_clostridium.pdf)
- Most registered products are chlorine-based, some HP/PA-based, one 4% HP
Disinfection of Noncritical Surfaces Bundle

- Develop policies and procedures
- Select cleaning and disinfecting products
- Educate staff-environmental services and nursing
- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance
Disinfection of Noncritical Surfaces Bundle

• Develop policies and procedures
  ■ Environmental cleaning and disinfection is an integral part of preventing transmission of pathogens
  ■ In addition to identifying products and procedures, ensure standardization of cleaning throughout the hospital
    ◆ Some units utilize ES to clean pieces of equipment (e.g., vital sign machines, IV pumps); some units use patient equipment, and some units utilize nursing staff.
    ◆ Multidisciplinary group to create a standardized plan for cleaning patient rooms and pieces of patient equipment throughout the hospital
Disinfection of Noncritical Surfaces Bundle
NL Havill AJIC 2013;41:S26-30

• Develop policies and procedures
• Select cleaning and disinfecting products
• Educate staff-environmental services and nursing
• Monitor compliance (thoroughness of cleaning, product use) and feedback
• Implement “no touch” room decontamination technology and monitor compliance
Effective Surface Decontamination

Product and Practice = Perfection
Thoroughness of Environmental Cleaning
Carling et al. ECCMID, Milan, Italy, May 2011

Graph showing the percentage of objects cleaned during daily and terminal cleaning across different settings such as HEHSG HOSP, IOWA HOSP, OTHER HOSP, OPERATING ROOMS, NICU, EMS VEHICLES, ICU DAILY, AMB CHEMO, MD CLINIC, LONG TERM, and DIALYSIS. The mean percentage cleaned is 32%. The graph includes a 95% confidence interval and indicates that more than 110,000 objects were cleaned at one site.
Practice* NOT Product

*surfaces not wiped
MONITORING THE EFFECTIVENESS OF CLEANING
Cooper et al. AJIC 2007;35:338

- Visual assessment-not a reliable indicator of surface cleanliness
- **ATP bioluminescence**—measures organic debris (each unit has own reading scale, <250-500 RLU)
- Microbiological methods—<2.5CFUs/cm²-pass; can be costly and pathogen specific
- Fluorescent marker-transparent, easily cleaned, environmentally stable marking solution that fluoresces when exposed to an ultraviolet light (applied by IP unbeknown to EVS, after EVS cleaning, markings are reassessed)
TERMINAL ROOM CLEANING: DEMONSTRATION OF IMPROVED CLEANING

- Evaluated cleaning before and after an intervention to improve cleaning
- 36 US acute care hospitals
- Assessed cleaning using a fluorescent dye

Interventions

- Increased education of environmental service workers
- Feedback to environmental service workers

†Regularly change “dotted” items to prevent targeting objects

Carling PC, et al. ICHE 2008;29:1035-41
Fluorescent marker is a useful tool in determining how thoroughly a surface is wiped and mimics the microbiological data better than ATP.
There was no statistical correlation between ATP levels and standard aerobic plate counts.
All “touchable” (hand contact) surfaces should be wiped with disinfectant.

“High touch” objects only recently defined (no significant differences in microbial contamination of different surfaces) and “high risk” objects not epidemiologically defined.
### MICROBIAL BURDEN ON ROOM SURFACES AS A FUNCTION OF FREQUENCY OF TOUCHING

<table>
<thead>
<tr>
<th>Surface</th>
<th>Prior to Cleaning Mean CFU/RODAC (95% CI)</th>
<th>Post Cleaning (mean) Mean CFU/RODAC (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>71.9 (46.5-97.3)</td>
<td>9.6</td>
</tr>
<tr>
<td>Medium</td>
<td>44.2 (28.1-60.2)</td>
<td>9.3</td>
</tr>
<tr>
<td>Low</td>
<td>56.7 (34.2-79.2)</td>
<td>5.7</td>
</tr>
</tbody>
</table>

- The level of microbial contamination of room surfaces is similar regardless of how often they are touched both before and after cleaning.
- Therefore, all surfaces that are touched must be cleaned and disinfected.

Future Methods to Ensure Thoroughness
Future May Have Methods to Ensure Thoroughness Such as Colorized Disinfectant
Kang et al. J Hosp Infect 2017

Colorized disinfection – contact time compliance

- Color-fading time matched to disinfectant contact time --> enforces compliance
- Provides real-time feedback when disinfection is complete
- Trains staff on importance of contact time as they use the product
Colorized disinfection – improved coverage

• Increased visibility when disinfecting surfaces, fewer missed spots
• Real-time quality control that allows staff to monitor thoroughness of cleaning
Disinfection of Noncritical Surfaces Bundle

- Develop policies and procedures
- Select cleaning and disinfecting products
- Educate staff-environmental services and nursing
- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance
These interventions (effective surface disinfection, thoroughness indicators) not enough to achieve consistent and high rates of cleaning/disinfection

No Touch
(supplements but do not replace surface cleaning/disinfection)
“NO TOUCH” APPROACHES TO ROOM DECONTAMINATION

(UV/VHP~20 microbicidal studies, 12 HAI reduction studies; will not discuss technology with limited data)

Enhanced Disinfection Leading to Reduction of Microbial Contamination and a Decrease in Patient Col/Infection


All enhanced disinfection technologies were significantly superior to Quat alone in reducing EIPs. Comparing the best strategy with the worst strategy (i.e., Quat vs Quat/UV) revealed that a reduction of 94% in EIP (60.8 vs 3.4) led to a 35% decrease in colonization/infection (2.3% vs 1.5%). Our data demonstrated that a decrease in room contamination was associated with a decrease in patient colonization/infection. First study which quantitatively described the entire pathway whereby improved disinfection decreases microbial contamination which in-turn reduced patient colonization/infection.
This technology ("no touch"—e.g., UV/HP) should be used (capital equipment budget) for terminal room disinfection (e.g., after discharge of patients on Contact Precautions).
Disinfection of Noncritical Surfaces Bundle

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- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance

NL Havill AJIC 2013;41:S26-30
Skin Antisepsis: CHG Treatment and Skin Site Preparation

- Skin Antisepsis
  - Pre-operative
  - Surgical site
- CHG Bathing/Treatment
SSI: Primary Risk Factors

- Endogenous microorganisms
  - Skin-dwelling microorganisms
    - Most common source
    - *S. aureus* most common isolate
    - Fecal flora (gnr) when incisions are near the perineum or groin

- Exogenous microorganisms
  - Surgical personnel (members of surgical team)
  - OR environment (including air)
  - All tools, instruments, and materials
Surgical site infections were the most prevalent type of HAI in 2019, accounting for 29% of all HAI in 2019; in 2018, SSIs accounted for 25% and in 2017, they were 19%
Why are we doing this?

Top Ten Pathogens Causing Healthcare Associated Surgical Site Infections, 2018

Skin organisms
SSI: Preoperative Issues
Modifiable Risks

Glucose control-in diabetic patients
Preoperative CHG shower
Appropriate hair removal
Hand hygiene
Skin antisepsis
Antimicrobial prophylaxis
Normothermia-hypo higher risks

5 Million lives. Institute for Healthcare Improvement. Available at:
Skin Antisepsis: CHG Treatment and Skin Site Preparation

• Skin Antisepsis
  ■ Pre-operative
  ■ Surgical site

• CHG Bathing/Treatment
Normal Skin Micro-Flora

Numbers of bacteria that colonize different parts of the body

Numbers per square centimeter of skin surface (cfu/cm²). Counts on hands range from 3.9x10⁴ to 4.6x10⁶.
Microbial Ecology of Skin Surface

- Scalp: $6.0 \log_{10} \text{ cfu/cm}^2$
- Axilla: $5.5 \log_{10} \text{ cfu/cm}^2$
- Abdomen: $4.3 \log_{10} \text{ cfu/cm}^2$
- Forearm: $4.0 \log_{10} \text{ cfu/cm}^2$
- Hands: $4.0-6.6 \log_{10} \text{ cfu/cm}^2$
- Perineum: $7.0-11.0 \log_{10} \text{ cfu/cm}^2$
Skin Antisepsis: CHG Treatment and Skin Site Preparation

• Skin Antisepsis
  ■ Pre-operative
  ■ Surgical site

• CHG Bathing/Treatment
4% Chlorhexidine Gluconate (CHG) Shower - Mean Skin Surface Concentration (N=60)

CHG Shower
- Group 1A "Evening (PM)"
- Group 2A "Morning (AM)"
- Group 3A "Both (AM and PM)"

$p < 0.05$

NS

$P < 0.001$

$MIC_{90} = 4.8$ ppm

- Left Elbow
- Right Elbow
- Abdominal
- Left Knee
- Right Knee

Surgical Site Infection Initiative

Pre-Operative CHG Treatment (Wipes)

Training Materials February 2020
Why are we doing this?

• Studies have shown decreases in surgical site infections with the introduction of a pre-operative antiseptic bathing/treatment protocol.\(^1,2\)

• To gain the maximum antiseptic effect of chlorhexidine gluconate (CHG), adequate amounts must be maintained on the skin.\(^3\)

• The average CHG concentration is higher with cloths vs. liquid soap (65.4 vs 20.8 ppm).\(^4\)
Who will receive a CHG Treatment?

• Patients should receive a CHG treatment the night-before and the day-of surgery.
  • Exclude patients having surgery above the neck (eye, dental, etc.) or having non-surgical procedures performed in the OR or other procedural area (bronchoscopy, GI endoscopy, etc.)
• Inpatients will receive both treatments on the unit where they are housed.
  • The day-of treatment should be given within the 6 hours before surgery.
• Patients arriving from home for surgery will receive day-of treatment in Pre-op.
How do we apply the wipes? (Adults)

Using the 6 wipes, rub each area of the skin gently for 20 seconds each:

1. Wipe the neck, shoulders, and chest
2. Wipe both armpits, arms and hands
3. Wipe the abdomen and around the groin area, but not the genitals
4. Wipe the right leg and foot
5. Wipe the left leg and foot
6. Wipe the back and buttocks, but not the anus

Do not wipe off, but allow the skin to air dry especially skin folds

Wipe downward from your neck to the toes

Apply wipes to dry skin - Patient may feel sticky for about 2 minutes - Do not rinse off - Do not apply lotion - Do not flush wipes
Skin Antisepsis: CHG Treatment and Skin Site Preparation

• Skin Antisepsis
  ■ Pre-operative
  ■ Surgical site

• CHG Treatment/Bathing
Surgical Site Preparation

- Alcohol-containing preparation (e.g., CHG-alcohol, iodophor-alcohol)
  - SHEA
  - CDC
- Alcohol-containing antiseptic solution containing CHG
  - WHO
Skin Antisepsis: CHG Treatment and Skin Site Preparation

- Skin Antisepsis
  - Pre-operative
  - Surgical site
- CHG Treatment/Bathing
Patients C/I with healthcare pathogens on their skin

Such contamination may lead to infection when factors such as devices, catheters and wounds provide a route for pathogens on skin to reach sterile sites.

Skin contamination may also contribute to transmission due to environmental shedding and transfer to hands of personnel

Strong rationale for efforts to reduce the burden of pathogens on skin
CHG Treatment/Bathing Prevents Infection, Reduces Skin Burden and Environmental Contamination

Donskey C. AJIC 2016;44:e17

Decreased skin contamination, hand contamination, environmental contamination and reduced VREs in ICU. Vernon et al. Arch Intern Med 2006;166:306-312

Fig 1. Effect of daily chlorhexidine bathing on skin and environmental contamination and acquisition of vancomycin-resistant enterococci (VRE).
CHG Treatment Prevents Infection, Reduces Skin Burden and Environmental Contamination

Donskey C. AJIC 2016;44:e17

12 of 14 (86%) studies, CHG was associated with a significant reduction in C/I

<table>
<thead>
<tr>
<th>Study</th>
<th>Setting</th>
<th>Chlorhexidine Formulation</th>
<th>Design</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Medical intensive care unit</td>
<td>2% chlorhexidine gluconate (CHG)-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>Decreased vancomycin-resistant enterococci on patients’ skin, health care workers’ hands, and environment</td>
</tr>
<tr>
<td>11</td>
<td>Medical intensive care unit</td>
<td>4% CHG solution</td>
<td>Quasiexperimental</td>
<td>Decreased Acinetobacter baumannii skin colonization and bloodstream infections</td>
</tr>
<tr>
<td>10</td>
<td>Medical intensive care wards</td>
<td>2% CHG-impregnated cloths</td>
<td>2 arm crossover trial</td>
<td>Decreased primary bloodstream infections</td>
</tr>
<tr>
<td>6</td>
<td>Medical intensive care unit</td>
<td>2% CHG-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>Decreased central line–associated bloodstream infections and blood culture contamination</td>
</tr>
<tr>
<td>12</td>
<td>Intensive care units in 4 hospitals</td>
<td>2% CHG-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>Decreased acquisition of methicillin–resistant Staphylococcus aureus and vancomycin–resistant enterococci</td>
</tr>
<tr>
<td>17</td>
<td>Long-term acute care hospital</td>
<td>2% CHG solution</td>
<td>Quasiexperimental</td>
<td>Decreased vancomycin-resistant enterococci bacteremia</td>
</tr>
<tr>
<td>9</td>
<td>Intensive care units</td>
<td>4% CHG solution plus chlorhexidine acetate powder to groin, axilla, and skin folds</td>
<td>Quasiexperimental</td>
<td>Decreased central line–associated bloodstream infection</td>
</tr>
<tr>
<td>14</td>
<td>Trauma intensive care unit</td>
<td>2% CHG-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>Decreased acquisition of methicillin–resistant S. aureus (non-qacA/B) strains</td>
</tr>
<tr>
<td>19</td>
<td>Surgical intensive care unit</td>
<td>2% CHG-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>Decreased methicillin–resistant S. aureus and Acinetobacter spp colonization</td>
</tr>
<tr>
<td>13</td>
<td>Trauma center intensive care unit</td>
<td>2% CHG-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>Decreased central line–associated bloodstream infection</td>
</tr>
<tr>
<td>16</td>
<td>4 Medical wards</td>
<td>2% CHG-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>No decrease in central line–associated bloodstream infection</td>
</tr>
<tr>
<td>21</td>
<td>Hospital-wide</td>
<td>4% CHG solution applied as bed bath or shower daily or 3 times per week</td>
<td>Quasiexperimental</td>
<td>Decreased C difficile infections</td>
</tr>
<tr>
<td>8</td>
<td>Oncology patients</td>
<td>2% CHG-impregnated cloths</td>
<td>Quasiexperimental</td>
<td>No change in other hospital–associated infections</td>
</tr>
<tr>
<td>15</td>
<td>4 Long-term acute care hospitals</td>
<td>2% CHG-impregnated cloths</td>
<td>Stepped wedge bundle</td>
<td>Decreased acquisition of vancomycin–resistant enterococci colonization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Decreased Klebsiella pneumoniae carbapenemase–producing enterobacteriaceae colonization and infection, all-cause bacteremia, and blood culture contamination</td>
</tr>
</tbody>
</table>
Impact of CHG Treatment/Bathing on HA Bloodstream Infections
Musuuza et al. BMC Infect Disd 2019;19:416

The incidence rate of BSI was reduced by ~40% (26 studies)

<table>
<thead>
<tr>
<th>Study</th>
<th>IRR (95% CI)</th>
<th>Events, CHG</th>
<th>Events, Comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camus 2005</td>
<td>0.20 (0.02, 1.69)</td>
<td>1/1991</td>
<td>5/1961</td>
</tr>
<tr>
<td>Bleasdale 2007</td>
<td>0.39 (0.18, 0.86)</td>
<td>9/2210</td>
<td>22/2119</td>
</tr>
<tr>
<td>Borer 2007</td>
<td>0.16 (0.04, 0.70)</td>
<td>2/1600</td>
<td>15/1923</td>
</tr>
<tr>
<td>Gould 2007</td>
<td>0.68 (0.56, 0.82)</td>
<td>171/6664</td>
<td>264/6899</td>
</tr>
<tr>
<td>Clime 2009</td>
<td>0.34 (0.18, 0.62)</td>
<td>14/15472</td>
<td>41/1522</td>
</tr>
<tr>
<td>Holder 2009</td>
<td>1.00 (0.22, 4.47)</td>
<td>2/3333</td>
<td>12/20000</td>
</tr>
<tr>
<td>Munoz-Price 2009</td>
<td>0.40 (0.26, 0.63)</td>
<td>29/7632</td>
<td>55/6210</td>
</tr>
<tr>
<td>Popovich 2009</td>
<td>0.13 (0.03, 0.54)</td>
<td>2/5610</td>
<td>19/6728</td>
</tr>
<tr>
<td>Dixon 2010</td>
<td>0.28 (0.12, 0.64)</td>
<td>7/3148</td>
<td>27/3346</td>
</tr>
<tr>
<td>Evans 2010</td>
<td>0.25 (0.08, 0.76)</td>
<td>4/1904</td>
<td>15/1785</td>
</tr>
<tr>
<td>Popovich 2010</td>
<td>1.14 (0.59, 2.18)</td>
<td>17/5799</td>
<td>19/7366</td>
</tr>
<tr>
<td>Kassakian 2011</td>
<td>0.96 (0.31, 2.98)</td>
<td>6/36185</td>
<td>6/34800</td>
</tr>
<tr>
<td>Montecalvo 2012</td>
<td>0.66 (0.43, 1.04)</td>
<td>25/6466</td>
<td>85/14556</td>
</tr>
<tr>
<td>Clime 2013</td>
<td>0.72 (0.57, 0.92)</td>
<td>119/24902</td>
<td>165/24983</td>
</tr>
<tr>
<td>Huang 2013</td>
<td>0.59 (0.52, 0.68)</td>
<td>356/101603</td>
<td>412/66668</td>
</tr>
<tr>
<td>Martinez-Reséndez 2014</td>
<td>0.55 (0.35, 0.85)</td>
<td>25/3125</td>
<td>84/5664</td>
</tr>
<tr>
<td>Popp 2014</td>
<td>0.15 (0.01, 3.07)</td>
<td>0/277</td>
<td>2/203</td>
</tr>
<tr>
<td>Cassir 2015</td>
<td>0.50 (0.25, 0.97)</td>
<td>12/1344</td>
<td>28/1546</td>
</tr>
<tr>
<td>Hayden 2015</td>
<td>0.68 (0.63, 0.74)</td>
<td>870/14070</td>
<td>2004/178516</td>
</tr>
<tr>
<td>Noto 2015</td>
<td>0.92 (0.70, 1.20)</td>
<td>100/9231</td>
<td>117/20689</td>
</tr>
<tr>
<td>Abbud 2016</td>
<td>0.59 (0.27, 1.31)</td>
<td>14/28914</td>
<td>11/13508</td>
</tr>
<tr>
<td>Amirov 2016</td>
<td>0.25 (0.03, 2.03)</td>
<td>1/10000</td>
<td>7/17500</td>
</tr>
<tr>
<td>Booyarsir 2016</td>
<td>1.27 (0.23, 6.46)</td>
<td>2/202</td>
<td>4/512</td>
</tr>
<tr>
<td>Swan 2016</td>
<td>0.21 (0.01, 4.27)</td>
<td>0/952</td>
<td>2/976</td>
</tr>
<tr>
<td>Daszyńska 2017</td>
<td>0.32 (0.14, 0.71)</td>
<td>8/1157</td>
<td>23/1050</td>
</tr>
</tbody>
</table>

Overall (I-squared = 50.3%, p = 0.002)
Guiding principle of infection prevention is effective implementation of interventions requires monitoring of compliance of staff with feedback on performance. Measuring CHG on skin a means to monitor effectiveness.
Growing body of evidence has accumulated suggesting that CHG treatment/bathing may be a beneficial strategy to prevent C/I with healthcare pathogens

Reduction in skin carriage may reduce dissemination of pathogens to the environment and hands of personnel

This practice is now becoming routine, particularly in ICUs

To optimize bathing in real-world settings, need to develop strategies to monitor compliance
Tips for Success

• Use daily on:
  ✓ ICUs
  ✓ Step down
  ✓ Oncology units (adults and pediatrics)

• Educate caregivers about the importance of daily CHG treatment in reducing infections

• Document “chlorhexidine treatment (not bath)” as given or refused (under daily cares/hygiene)

• Dispose of wipes in the trash can
Best Practices in Disinfection of Noncritical Surfaces in the Healthcare Setting: A Bundle Approach

Skin Antisepsis: CHG Treatment and Skin Site Prep
MRSA, VRE, *C. difficile*, MDR-*Acinetobacter* comprise a growing reservoir of epidemiologically important pathogens that have an environmental mode of transmission.

- Implement evidence-based practices for surface disinfection
  - Evidence-based policies
  - Ensure use of safe and effective (against emerging pathogens such as *C. auris* and CRE) low-level disinfectants
  - Ensure thoroughness of cleaning (new thoroughness technology)

- Use “no touch” room decontamination technology proven to reduce microbial contamination on surfaces and reduction of HAIs at terminal/discharge cleaning.
Contraindications

Don’t use wipes if patient has:
- CHG allergy
- radiation treatment that day
- Thiotepa chemotherapy (follow same protocol as with CHG liquid)

Avoid:
- areas with rashes, moderate or severe burns, severe skin breakdown or open wounds
- head and face
- lotions from home. Many lotions deactivate CHG especially nice smelling lotions
- rinsing off – These are no-rinse wipes (Still encourage hand washing)

Don’t:
- put wipes in with the soap & water bath – the wipes won’t work
- put wipes in the microwave or blanket warmer
- flush in the toilet
- use for Foley care – Follow urinary pericare policy
Skin Antisepsis: CHG Treatment and Skin Site Preparation

• Surgical Site Preparation
  ■ Pre-operative-shower or CHG wipes (night before, morning)
  ■ Current evidence favors the use of alcohol-containing solutions, often containing CHG or povidone-iodine, for surgical site preparation

• CHG Bathing/Treatment
  ■ Growing body of evidence has accumulated suggesting that CHG bathing/treatment may be a beneficial strategy to prevent C/I with healthcare pathogens
THANK YOU!

www.disinfectionandsterilization.org