Role of Environmental Surfaces in Disease Transmission: “No Touch” Technologies Reduce HAIs

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Disclosure: Clorox

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“No Touch” Technologies Reduce HAIs

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- Review the use of low-level disinfectants and the selection of the ideal disinfectant
- Review “best” practices for environmental cleaning and disinfection
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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
ENVIROMENTAL 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
KEY PATHOGENS WHERE ENVIRONMENTAL 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>Outbreak</th>
<th>Endemic</th>
<th>Site estimated means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rampling et al**</td>
<td>Boyce et al**</td>
</tr>
<tr>
<td>Floor</td>
<td>9%</td>
<td>50-55%</td>
</tr>
<tr>
<td>Bed linen</td>
<td>..</td>
<td>38-54%</td>
</tr>
<tr>
<td>Patient gown</td>
<td>..</td>
<td>40-53%</td>
</tr>
<tr>
<td>Overbed table</td>
<td>..</td>
<td>18-42%</td>
</tr>
<tr>
<td>Blood pressure cuff</td>
<td>13%</td>
<td>25-33%</td>
</tr>
<tr>
<td>Bed or siderails</td>
<td>5%</td>
<td>1-30%</td>
</tr>
<tr>
<td>Bathroom door handle</td>
<td>13%</td>
<td>8-24%</td>
</tr>
<tr>
<td>Infusion pump button</td>
<td>13%</td>
<td>/-18%</td>
</tr>
<tr>
<td>Room door handle</td>
<td>11%</td>
<td>4-8%</td>
</tr>
<tr>
<td>Furniture</td>
<td>11%</td>
<td>..</td>
</tr>
<tr>
<td>Flat surfaces</td>
<td>7%</td>
<td>..</td>
</tr>
<tr>
<td>Sink taps or basin fitting</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Average quoted**</td>
<td>11%</td>
<td>27%</td>
</tr>
</tbody>
</table>

ENVIRONMENTAL SURVIVAL OF KEY PATHOGENS ON HOSPITAL SURFACES

Pathogen                                      Survival Time
S. aureus (including MRSA)                  7 days to >12 months
Enterococcus spp. (including VRE)          5 days to >46 months
Acinetobacter spp.                          3 days to 11 months
Clostridium difficile (spores)              >5 months
Norovirus (and feline calicivirus)          8 hours to >2 weeks
Pseudomonas aeruginosa                     6 hours to 16 months
Klebsiella spp.                             2 hours to >30 months


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)

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%)

RISK OF ACQUIRING PATHOGEN FROM PRIOR ROOM OCCUPANT~120%

* Prior room occupant infected; ^Any room occupant in prior 2 weeks infected
EVALUATION OF HOSPITAL ROOM ASSIGNMENT AND ACQUISITION OF CDI

- Study design: Retrospective cohort analysis, 2005-2006
- Setting: Medical ICU at a tertiary care hospital
- Methods: All patients evaluated for diagnosis of CDI 48 hours after ICU admission and within 30 days after ICU discharge
- Results (acquisition of CDI)
  - Admission to room previously occupied by CDI = 11.0%
  - Admission to room not previously occupied by CDI = 4.6% (p=0.002)

Shaughnessy MK, et al. ICHE 2011;32:201-206

TRANSMISSION MECHANISMS INVOLVING THE SURFACE ENVIRONMENT

TRANSMISSION MECHANISMS INVOLVING THE SURFACE ENVIRONMENT


ACQUISITION OF MRSA ON HANDS AFTER CONTACT WITH ENVIRONMENTAL SITES
ACQUISITION OF MRSA ON HANDS/GLOVES AFTER CONTACT WITH CONTAMINATED EQUIPMENT

TRANSFER OF MRSA FROM PATIENT OR ENVIRONMENT TO IV DEVICE AND TRANSMISSION OF PATHOGEN
TRANSMISSION MECHANISMS INVOLVING THE SURFACE ENVIRONMENT


ACQUISITION OF *C. difficile* ON PATIENT HANDS AFTER CONTACT WITH ENVIRONMENTAL SITES AND THEN INOCULATION OF MOUTH
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
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
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.
ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

- There is increasing evidence to support the contribution of the environment to disease transmission
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Role of Environmental Surfaces in Disease Transmission

“No Touch” Technologies Reduce HAIs

- Review the role of environmental surfaces
- Review the use of low-level disinfectants and the selection of the ideal disinfectant
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- Discuss options for evaluating environmental cleaning and disinfection
- Discuss new “no touch” technologies for room decontamination and reduction of HAIs
EH Spaulding believed that how an object will be disinfected depended on the object’s intended use

- CRITICAL - objects which enter normally sterile tissue or the vascular system or through which blood flows should be sterile
- SEMICRITICAL - objects that touch mucous membranes or skin that is not intact require a disinfection process (high-level disinfection [HLD]) that kills all microorganisms; however, small numbers of bacterial spores are permissible.
- NONCRITICAL - objects that touch only intact skin require low-level disinfection

Effective Surface Decontamination

Product and Practice = Perfection
Effective Surface Decontamination

Product and Practice = Perfection

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</td>
<td>UD</td>
</tr>
<tr>
<td>Improved hydrogen peroxide</td>
<td>0.5%, 1.4%</td>
</tr>
</tbody>
</table>

UD=Manufacturer’s recommended use dilution
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.

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
Key Considerations for Selecting the Ideal Disinfectant for Your Facility

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Question to Ask</th>
<th>Score (1-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill Claims</td>
<td>Does the product kill the most prevalent healthcare pathogens</td>
<td></td>
</tr>
<tr>
<td>Kill Times and Wet-</td>
<td>How quickly does the product kill the prevalent healthcare pathogens.</td>
<td></td>
</tr>
<tr>
<td>Contact Times</td>
<td>Ideally, contact time greater than or equal to the kill claim.</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Does the product have an acceptable toxicity rating, flammability rating</td>
<td></td>
</tr>
<tr>
<td>Ease-of-Use</td>
<td>Odor acceptable, shelf-life, in convenient forms (wipes, spray), water soluble,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>works in organic matter, one-step (cleans/disinfects)</td>
<td></td>
</tr>
<tr>
<td>Other factors</td>
<td>Supplier offer comprehensive training/education, 24-7 customer support, overall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cost acceptable (product capabilities, cost per compliant use, help standardize</td>
<td></td>
</tr>
<tr>
<td></td>
<td>disinfectants in facility</td>
<td></td>
</tr>
</tbody>
</table>

Note: Consider the 5 components shown, give each product a score (1 is worst and 10 is best) in each of the 5 categories, and select the product with the highest score as the optimal choice (maximum score is 50).

MOST PREVALENT PATHOGENS CAUSING HAI

- Most prevent pathogens causing HAI (~75% easy to kill)
  - *S. aureus* (15.6%)
  - *E. coli* (11.5%)
  - Coag neg Staph (11.4%)
  - *Klebsiella* (8.0%)
  - *P. aeruginosa* (8.0%)
  - *E. faecalis* (6.8%)
  - *C. albicans* (5.3%)
  - *Enterobacter* sp. (4.7%)
  - Other *Candida* sp (4.2%)
  - *C. difficile* in top 2-3 past 5 years

- Common causes of outbreaks and ward closures (relatively hard to kill)
  - *C. difficile* spores
  - Norovirus
  - Rotavirus
  - Adenovirus
EFFECTIVENESS OF DISINFECTANTS AGAINST MRSA AND VRE


Decreasing Order of Resistance of Microorganisms to Disinfectants/Sterilants

Most Resistant
- Prions
- Spores (C. difficile)
- Mycobacteria
- Non-Enveloped Viruses (norovirus)
- Fungi
- Bacteria (MRSA, VRE, Acinetobacter)

Most Susceptible
- Enveloped Viruses
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
- 34 registered products; most chlorine-based, some HP/PA-based

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Product and Practice = Perfection

SHOULD WE CONCENTRATE ON “HIGH TOUCH” OR “HIGH RISK” OBJECTS

No, not only “high risk” (all surfaces). “High touch” objects only recently defined and “high risk” objects not scientifically defined.
DEFINING HIGH TOUCH SURFACES


DEFINING HIGH TOUCH SURFACES

MICROBIAL BURDEN ON ROOM SURFACES AS A FUNCTION OF FREQUENCY OF TOUCHING

<table>
<thead>
<tr>
<th>Surface</th>
<th>Prior to Cleaning</th>
<th>Post Cleaning (mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean CFU/RODAC (95% CI)</td>
<td>Mean CFU/RODAC (95% CI)</td>
</tr>
<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.
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.
Wipes
Cotton, Disposable, Microfiber, Cellulose-Based, Nonwoven Spunlace

Wipes-cotton, disposable, microfiber, nonwoven spunlace

Wipe should have sufficient wetness to achieve the disinfectant contact time. Discontinue use of the wipe if no longer leaves the surface visible wet for ≥1 minute.

When the wipe is visibly soiled, flip to a clean/unused side and continue until all sides of the wipe have been used (or get another wipe)

Dispose of the wipe/cloth wipe appropriately

Do not re-dip a wipe into the clean container of pre-saturated wipes

WIPES
DISPOSABLE WIPES

- Wetness-ideally, stays wet long enough to meet EPA-registered contact times (e.g., bacteria-1 minute).
- Surface Coverage-premoistened wipe keeps surface area wet for 1-2 minutes (e.g., 12”x12” wipes keep 55.5 sq ft wet for 2m; 6”x5” equipment wipe keeps 6.7 sq ft wet for 2m). Wipe size based on use from small surfaces to large surfaces like mattress covers
- Durable substrate-will not easily tear or fall apart
- Top-keep closed or wipes dry out

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Thoroughness of Environmental Cleaning

Carling P. AJIC 2013;41:S20-S25

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)
DAZO Solution (AKA – Goo)

TARGET ENHANCED
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

SURFACE EVALUATION USING ATP BIOLUMINESCENCE

Swab surface → luciferase tagging of ATP → Hand held luminometer

Used in the commercial food preparation industry to evaluate surface cleaning before reuse and as an educational tool for more than 30 years.
Fluorescent marker is a useful tool in determining how thoroughly a surface is wiped and mimics the microbiological data better than ATP.

These interventions not enough to achieve consistent and high rates of cleaning/disinfection.

No Touch
(supplements but do not replace surface cleaning/disinfection)
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NEW “NO TOUCH” APPROACHES TO ROOM DECONTAMINATION
Supplement Surface Disinfection
Touch (Wiping) vs No-Touch (Mechanical)

No Touch
(supplements but do not replace surface cleaning/disinfection)
Formica Placement in the Patient Room

- Toilet seat
- Back of head-of-the-bed
- Back-of-computer
- Bedside table (far side)
- Side of sink
- Foot of bed, facing the door
- Bathroom door

UV Room Decontamination


- Fully automated, self calibrates, activated by hand-held remote
- Room ventilation does not need to be modified
- Uses UV-C (254 nm range) to decontaminate surfaces
- Measures UV reflected from walls, ceilings, floors or other treated areas and calculates the operation total dosing/time to deliver the programmed lethal dose for pathogens.
- UV sensors determines and targets highly-shadowed areas to deliver measured dose of UV energy
- After UV dose delivered (36,000µWs/cm² for spore, 12,000µWs/cm² for bacteria), will power-down and audibly notify the operator
- Reduces colony counts of pathogens by >99.9% within 20 minutes
Room Decontamination with UV

- **Objective:** Determine the effectiveness of a UVC device
- **Method:** Study carried out in standard hospital room using Formica sheets contaminated with MRSA, *C. difficile*
- **Results:** The effectiveness of UVC radiation in reducing MRSA was more than >99.9% within 5 min and the reduction of *C. difficile* spores was >99% within 10 min.
- **Conclusion:** This UVC device (UVDI) allowed room decontamination in 5-10 minutes
Room Decontamination with UV
Rutala, Gergen, Weber. ICHE. 2014. 35:1070-1072

UVDI delivers lethal dose of UV in 5-10 min (may be attributable to design (e.g., reflector)

<table>
<thead>
<tr>
<th>Organism (Decontamination Time)</th>
<th>Inoculum</th>
<th>Total Decontamination Log$_{10}$ Reduction</th>
<th>Direct Decontamination Log$_{10}$ Reduction</th>
<th>Indirect Decontamination Log$_{10}$ Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA (5 min)</td>
<td>4.80</td>
<td>3.56 (n=50)</td>
<td>4.10 (n=30)</td>
<td>2.74 (n=20)</td>
</tr>
<tr>
<td>C. difficile spores (10 min)</td>
<td>3.69</td>
<td>2.78 (n=50)</td>
<td>3.35 (n=30)</td>
<td>1.80 (n=20)</td>
</tr>
</tbody>
</table>

HYDROGEN PEROXIDE FOR DECONTAMINATION OF THE HOSPITAL ENVIRONMENT

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>HP System</th>
<th>Pathogen</th>
<th>Before HPV</th>
<th>After HPV</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>French, 2004</td>
<td>VHP</td>
<td>MRSA</td>
<td>61/85-72%</td>
<td>1/85-1%</td>
<td>98</td>
</tr>
<tr>
<td>Bates, 2005</td>
<td>VHP</td>
<td>Serratia</td>
<td>2/42-5%</td>
<td>0/24-0%</td>
<td>100</td>
</tr>
<tr>
<td>Jeanes, 2005</td>
<td>VHP</td>
<td>MRSA</td>
<td>10/28-36%</td>
<td>0/50-0%</td>
<td>100</td>
</tr>
<tr>
<td>Hardy, 2007</td>
<td>VHP</td>
<td>MRSA</td>
<td>7/29-24%</td>
<td>0/29-0%</td>
<td>100</td>
</tr>
<tr>
<td>Dryden, 2007</td>
<td>VHP</td>
<td>MRSA</td>
<td>8/29-28%</td>
<td>1/29-3%</td>
<td>88</td>
</tr>
<tr>
<td>Otter, 2007</td>
<td>VHP</td>
<td>MRSA</td>
<td>18/30-60%</td>
<td>1/30-3%</td>
<td>95</td>
</tr>
<tr>
<td>Boyce, 2008</td>
<td>VHP</td>
<td>C. difficile</td>
<td>11/43-26%</td>
<td>0/37-0%</td>
<td>100</td>
</tr>
<tr>
<td>Bartels, 2008</td>
<td>HP dry mist</td>
<td>MRSA</td>
<td>4/14-29%</td>
<td>0/14-0%</td>
<td>100</td>
</tr>
<tr>
<td>Shapay, 2008</td>
<td>HP dry mist</td>
<td>C. difficile</td>
<td>48/203-24%</td>
<td>7/203-3%</td>
<td>88</td>
</tr>
<tr>
<td>Barbut, 2009</td>
<td>HP dry mist</td>
<td>C. difficile</td>
<td>34/180-19%</td>
<td>4/180-2%</td>
<td>88</td>
</tr>
<tr>
<td>Otter, 2010</td>
<td>VHP</td>
<td>GNR</td>
<td>10/21-48%</td>
<td>0/63-0%</td>
<td>100</td>
</tr>
</tbody>
</table>
# Clinical Trials Using HP for Terminal Room Disinfection to Reduce HAIs


<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Design</th>
<th>Pathogen</th>
<th>Reduction in HAIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boyce, 2008</td>
<td>Before-After</td>
<td>CDI</td>
<td>Yes</td>
</tr>
<tr>
<td>Cooper, 2011</td>
<td>Before-After</td>
<td>CDI</td>
<td>Decrease cases (incidence not stated)</td>
</tr>
<tr>
<td>Passaretti, 2013</td>
<td>Prospective cohort</td>
<td>MRSA, VRE, CDI</td>
<td>Yes, in all MDROs</td>
</tr>
<tr>
<td>Manian, 2013</td>
<td>Before-After</td>
<td>CDI</td>
<td>Yes</td>
</tr>
<tr>
<td>Mitchell, 2014</td>
<td>Before-After</td>
<td>MRSA</td>
<td>Yes</td>
</tr>
</tbody>
</table>

# EFFECTIVENESS OF UV-C FOR ROOM DECONTAMINATION (Inoculated Surfaces)

ICHE 2010;31:1025; BMC 2010;10:197; ICHE 2011;32:737; JHI 2013;84:323l ICHE 2012;33:507-12 ICHE 2013;34:466 * μWs/cm²; min = minutes; NA = not available

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>Dose*</th>
<th>Mean log₁₀ Reduction</th>
<th>Mean log₁₀ Reduction</th>
<th>Time</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Line of Sight</td>
<td>Shadow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRSA, VRE, MDR-A</td>
<td>12,000</td>
<td>3.90-4.31</td>
<td>3.25-3.85</td>
<td>~15 min</td>
<td>Rutala W, et al.¹</td>
</tr>
<tr>
<td>C. difficile</td>
<td>36,000</td>
<td>4.04</td>
<td>2.43</td>
<td>~50 min</td>
<td>Rutala W, et al.¹</td>
</tr>
<tr>
<td>MRSA, VRE</td>
<td>12,000</td>
<td>&gt;2-3</td>
<td>NA</td>
<td>~20 min</td>
<td>Nerandzic M, et al.²</td>
</tr>
<tr>
<td>C. difficile</td>
<td>22,000</td>
<td>&gt;2-3</td>
<td>NA</td>
<td>~45 min</td>
<td>Nerandzic M, et al.²</td>
</tr>
<tr>
<td>C. difficile</td>
<td>22,000</td>
<td>2.3</td>
<td>overall</td>
<td>67.8 min</td>
<td>Boyce J, et al.³</td>
</tr>
<tr>
<td>MRSA, VRE, MDR-A, Asp</td>
<td>12,000</td>
<td>3.5-&gt;4.0</td>
<td>1.7-&gt;4.0</td>
<td>30-40 min</td>
<td>Mahida N, et al.⁴</td>
</tr>
<tr>
<td>MRSA, VRE, MDR-A, Asp</td>
<td>22,000</td>
<td>&gt;4.0*</td>
<td>1.0-3.5</td>
<td>60-90 min</td>
<td>Mahida N, et al.⁴</td>
</tr>
<tr>
<td>C. difficile, G. stear spore</td>
<td>22,000</td>
<td></td>
<td>overall</td>
<td>73 min</td>
<td>Havill N et al⁵</td>
</tr>
<tr>
<td>VRE, MRSA, MDR-A</td>
<td>12,000</td>
<td>1.61</td>
<td>1.18</td>
<td>25 min</td>
<td>Anderson et al⁶</td>
</tr>
</tbody>
</table>
Clinical Trials Using UV for Terminal Room Decontamination to Reduce HAIs

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Design</th>
<th>Pathogens</th>
<th>Reduction in HAIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levin, 2013</td>
<td>Before-After, Pulsed Xenon</td>
<td>CDI</td>
<td>Yes</td>
</tr>
<tr>
<td>Hass, 2014</td>
<td>Before-After, Pulsed Xenon</td>
<td>CDI, MRSA, VRE, MDRO-GNR</td>
<td>Yes</td>
</tr>
<tr>
<td>Miller, 2015</td>
<td>Before-After, Pulsed Xenon</td>
<td>CDI</td>
<td>Yes</td>
</tr>
<tr>
<td>Nagaraja, 2015</td>
<td>Before-After, Pulsed Xenon</td>
<td>CDI</td>
<td>Yes (p=0.06)</td>
</tr>
<tr>
<td>Pegues, 2015</td>
<td>Before-After, Optimum</td>
<td>CDI</td>
<td>Yes</td>
</tr>
<tr>
<td>Anderson, 2015</td>
<td>Randomized-controlled trial, Tru-D</td>
<td>MRSA, VRE, CDI</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Based on 12 studies, this technology should be used (capital equipment budget) for terminal room disinfection (e.g., after discharge of patients under CP).
UV ROOM DECONTAMINATION:
ADVANTAGES AND DISADVANTAGES
Rutala WA, Weber DJ. AJIC 2013;41:s36

● Advantages
  ■ Reliable biocidal activity against a wide range of pathogens
  ■ Studies demonstrating a reduction in HAIs
  ■ Surfaces and equipment decontaminated
  ■ Room decontamination is rapid (5-25 min) for vegetative bacteria
  ■ HVAC system does not need to be disabled and room does not need to be sealed
  ■ UV is residual free and does not give rise to health and safety concerns
  ■ No consumable products so operating costs are low (key cost = acquisition)

● Disadvantages
  ■ Can only be done for terminal disinfection (i.e., not daily cleaning)
  ■ All patients and staff must be removed from room
  ■ Substantial capital equipment costs
  ■ Does not remove dust and stains which are important to patients/visitors
  ■ Sensitive use parameters (e.g., UV dose delivered)

HP ROOM DECONTAMINATION:
ADVANTAGES AND DISADVANTAGES
Rutala WA, Weber DJ. AJIC 2013;41:s36

● Advantages
  ■ Reliable biocidal activity against a wide range of pathogens
  ■ Studies demonstrate a reduction in HAIs
  ■ Surfaces and equipment decontaminated
  ■ Residual free and does not give rise to health and safety concerns (aeration units convert HPV into oxygen and water)
  ■ Useful for disinfecting complex equipment and furniture
  ■ Does not require direct or indirect line of sight

● Disadvantages
  ■ Can only be done for terminal disinfection (i.e., not daily cleaning)
  ■ All patients and staff must be removed from room
  ■ Decontamination takes approximately 2.0 hours
  ■ HVAC system must be disabled and the room sealed with tape
  ■ Substantial capital equipment costs
  ■ Does not remove dust and stains which are important to patients/visitors
  ■ Sensitive use parameters (e.g., HP concentration)
Selection of a UV or HP Device

- Since different UV and hydrogen peroxide systems vary substantially, infection preventionists should review the peer-reviewed literature and choose only devices with demonstrated bactericidal capability as assessed by carrier tests and/or the ability to disinfect actual patient rooms
- Ideally, one would select a device that has demonstrated bactericidal capability and the ability to reduce HAIs

Role of Environmental Surfaces in Disease Transmission

- Review the role of environmental surfaces
- Review the use of low-level disinfectants and the selection of the ideal disinfectant
- Review “best” practices for environmental cleaning and disinfection
- Discuss options for evaluating environmental cleaning and disinfection
- Discuss new “no touch” technologies for room decontamination and reduction of HAIs
Role of the Environmental in Disease Transmission
“No Touch” Technologies Reduce HAIs

- Disinfection of noncritical environmental surfaces/equipment is an essential component of infection prevention
- Disinfection should render surfaces and equipment free of pathogens in sufficient numbers to cause human disease
- When determining the optimal disinfecting product, consider the 5 components (kill claims/time, safety, ease of use, others) and select the product with the highest score as the best choice for your healthcare facility
- Implement a method to improve the thoroughness of cleaning
- Goal: Product + Practice = Perfection
- An enhanced method of room decontamination is superior to a standard method
- “No touch” technology should be used at discharge for CP patients

THANK YOU!
www.disinfectionandsterilization.org
BEST PRACTICES FOR ROOM DISINFECTION

- Follow the CDC Guideline for Disinfection and Sterilization with regard to choosing an appropriate germicide and best practices for environmental disinfection.
- Appropriately train environmental service workers on proper use of PPE and clean/disinfection of the environment.
- Have environmental service workers use checklists to ensure all room surfaces are cleaned/disinfected.
- Assure that nursing and environmental service have agreed what items (e.g., sensitive equipment) are to be clean/disinfected by nursing and what items (e.g., environmental surfaces) are to be cleaned/disinfected by environmental service workers. Staff must have sufficient time. Increasing workload compromising infection control activities.
- Use a method (e.g., fluorescent dye, ATP) to ensure proper cleaning.