Environmental Disinfection: What Works Best? Mechanical Systems vs Elbow Grease

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Disclosure

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Objectives

• Environmental Disinfection: What Works Best
  – Environmental-relating to the environment (conditions surrounding a person or organism)
  – Disinfection-destruction of pathogenic microorganisms
  – What-which thing
  – Works-operates effectively or successfully
  – Best-exceeding all others in excellence

• Role of environment in transmission

• Evaluate the efficacy of surface disinfection ("elbow grease")

• Evaluate the efficacy of room decontamination units-UV, HP
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HAZARDS IN THE HOSPITAL

MRSA, VRE, C. difficile, Acinetobacter spp., norovirus

Endogenous flora 40-60%
Cross-infection (hands): 20-40%
Antibiotic driven: 20-25%
Other (environment): 20%

THE ROLE OF THE ENVIRONMENT IN DISEASE TRANSMISSION

• Over the past decade there has been a growing appreciation that environmental contamination makes a contribution to HAI with MRSA, VRE, *Acinetobacter*, norovirus and *C. difficile*

• Surface disinfection practices are currently not effective in eliminating environmental contamination

• Inadequate terminal cleaning of rooms occupied by patients with MDR pathogens places the next patients in these rooms at increased risk of acquiring these organisms
TRANSMISSION MECHANISMS INVOLVING THE SURFACE ENVIRONMENT

ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

• Frequent environmental contamination
  – MRSA, VRE, AB, CDI

• Microbial persistence in the environment
  – *In vitro* studies and environmental samples
  – MRSA, VRE, AB, CDI

• HCW hand contamination
  – MRSA, VRE, AB, CDI

• Relationship between level of environmental contamination and hand contamination
  – CDI
ENVIRONMENTAL CONTAMINATION LEADS TO HAIs

• Transmission directly or hands of HCWs
  – Molecular link
  – MRSA, VRE, AB, CDI

• Housing in a room previously occupied by a patient with the pathogen of interest is a risk factor for disease
  – MRSA, VRE, CDI

• Improved surface cleaning/disinfection reduces disease incidence
  – MRSA, VRE, CDI
KEY PATHOGENS WHERE ENVIRONMENTAL SURFACES PLAY A ROLE IN TRANSMISSION

• MRSA
• VRE
• *Acinetobacter* spp.
• *Clostridium difficile*
• Norovirus
• Rotavirus
• SARS
## ENVIRONMENTAL SURVIVAL OF KEY PATHOGENS

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Survival</th>
<th>Environmental Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>Days to weeks</td>
<td>2-3+</td>
</tr>
<tr>
<td>VRE</td>
<td>Days to weeks</td>
<td>3+</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>Days to months</td>
<td>2-3+</td>
</tr>
<tr>
<td><em>C. difficile</em></td>
<td>Months (spores)</td>
<td>3+</td>
</tr>
<tr>
<td>Norovirus</td>
<td>Days to weeks</td>
<td>3+</td>
</tr>
</tbody>
</table>

## ENVIRONMENTAL CONTAMINATION
### ENDEMIC AND EPIDEMIC MRSA

<table>
<thead>
<tr>
<th></th>
<th>Outbreak</th>
<th>Endemic</th>
<th>Site estimated mean $^5$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rampling et al$^{2*}$</td>
<td>Boyce et al$^{4**}$</td>
<td>Sexton et al$^{3†}$</td>
</tr>
<tr>
<td>Floor</td>
<td>9%</td>
<td>50-55%</td>
<td>44-60%</td>
</tr>
<tr>
<td>Bed linen</td>
<td>..</td>
<td>38-54%</td>
<td>44%</td>
</tr>
<tr>
<td>Patient gown</td>
<td>..</td>
<td>40-53%</td>
<td>..</td>
</tr>
<tr>
<td>Overbed table</td>
<td>..</td>
<td>18-42%</td>
<td>64-67%</td>
</tr>
<tr>
<td>Blood pressure cuff</td>
<td>13%</td>
<td>25-33%</td>
<td>..</td>
</tr>
<tr>
<td>Bed or siderails</td>
<td>5%</td>
<td>1-30%</td>
<td>44-60%</td>
</tr>
<tr>
<td>Bathroom door handle</td>
<td>..</td>
<td>8-24%</td>
<td>..</td>
</tr>
<tr>
<td>Infusion pump button</td>
<td>13%</td>
<td>7-18%</td>
<td>..</td>
</tr>
<tr>
<td>Room door handle</td>
<td>11%</td>
<td>4-8%</td>
<td>..</td>
</tr>
<tr>
<td>Furniture</td>
<td>11%</td>
<td>..</td>
<td>44-59%</td>
</tr>
<tr>
<td>Flat surfaces</td>
<td>7%</td>
<td>..</td>
<td>32-38%</td>
</tr>
<tr>
<td>Sink taps or basin fitting</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Average quoted$^{*}$</td>
<td>11%</td>
<td>27%</td>
<td>49%</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)

FREQUENCY OF ENVIRONMENTAL CONTAMINATION AND RELATION TO HAND CONTAMINATION

- Study design: Prospective study, 1992
- Setting: Tertiary care hospital
- Methods: All patients with CDI assessed with environmental cultures
- Results
  - Environmental contamination frequently found (25% of sites) but higher if patients incontinent (>90%)
  - Level of contamination low (<10 colonies per plate)
  - Presence on hands correlated with prevalence of environmental sites

Risk of Acquiring MRSA and VRE from Prior Room Occupants

- Admission to a room previously occupied by an MRSA-positive patient or VRE-positive patient significantly increased the odds of acquisition for MRSA and VRE (although this route is a minor contributor to overall transmission). Arch Intern Med 2006;166:1945.

- Prior environmental contamination, whether measured via environmental cultures or prior room occupancy by VRE-colonized patients, increases the risk of acquisition of VRE. Clin Infect Dis 2008;46:678.

- Prior room occupant with CDAD is a significant risk for CDAD acquisition. Shaughnessy et al. ICHE 2011;32:201
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• Evaluate the efficacy of surface disinfection (“elbow grease”)
• Evaluate the efficacy of room decontamination units-UV, HP
Touch (Elbow Grease) vs No-Touch (Mechanical)
Wipes
Cotton, Disposable, Microfiber

Wipe should have sufficient wetness to achieve the disinfectant contact time. Discontinue use of a disposable wipe if it no longer leaves the surface visibly wet for $\geq 1\text{m}$
## SURFACE DISINFECTION
### Effectiveness of Different Methods

<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>

THOROUGHNESS OF ENVIRONMENTAL CLEANING
Carling et al. ECCMID, Milan, Italy, May 2011

Mean = 32%
Mean proportion of surfaces disinfected at cleaning is 32%.

Terminal cleaning methods ineffective (products effective practices deficient [surfaces not wiped]) in eliminating epidemiologically important pathogens.
Effective Surface Decontamination

Practice and Product
Practice* NOT Product

*surfaces not wiped
Thoroughness of Environmental Cleaning

Carling et al. ECCMID, Milan, Italy, May 2011

Mean = 32%

>110,000 Objects

Mean = 32%

14 Sites 16 Sites 7 Sites 7 Sites 7 Sites 4 Sites 4 Sites 4 Sites 9 Sites 4 Sites

DAILY CLEANING
TERMINAL CLEANING

Objects

Mean = 32%

Mean = 32%
<table>
<thead>
<tr>
<th>Object</th>
<th>Percentage cleaned</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
</tr>
<tr>
<td>Sink</td>
<td>82 ± 12</td>
<td>57-97</td>
</tr>
<tr>
<td>Toilet seat</td>
<td>76 ± 18</td>
<td>40-98</td>
</tr>
<tr>
<td>Tray table</td>
<td>77 ± 15</td>
<td>53-100</td>
</tr>
<tr>
<td>Bedside table</td>
<td>64 ± 22</td>
<td>23-100</td>
</tr>
<tr>
<td>Toilet handle</td>
<td>60 ± 22</td>
<td>23-89</td>
</tr>
<tr>
<td>Side rail</td>
<td>60 ± 21</td>
<td>25-96</td>
</tr>
<tr>
<td>Call box</td>
<td>50 ± 19</td>
<td>9-90</td>
</tr>
<tr>
<td>Telephone</td>
<td>49 ± 16</td>
<td>18-86</td>
</tr>
<tr>
<td>Chair</td>
<td>48 ± 28</td>
<td>11-100</td>
</tr>
<tr>
<td>Toilet door knobs</td>
<td>28 ± 22</td>
<td>0-82</td>
</tr>
<tr>
<td>Toilet hand hold</td>
<td>28 ± 23</td>
<td>0-90</td>
</tr>
<tr>
<td>Bedpan cleaner</td>
<td>25 ± 18</td>
<td>0-79</td>
</tr>
<tr>
<td>Room door knobs</td>
<td>23 ± 19</td>
<td>2-73</td>
</tr>
<tr>
<td>Bathroom light switch</td>
<td>20 ± 21</td>
<td>0-81</td>
</tr>
</tbody>
</table>

Note. CI, confidence interval.
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Touch (Elbow Grease) vs No-Touch (Mechanical)

No Touch

(supplements but do not replace surface cleaning/disinfection)
No Touch

Systems that are fully automated and generally do not require personnel intervention once the treatment is initiated.
# Room Decontamination Units

Rutala, Weber. ICHE. 2011;32:743

## Table 1. Comparison of Room Decontamination Systems That Use UV Irradiation and Hydrogen Peroxide (HP)

<table>
<thead>
<tr>
<th></th>
<th>Sterinis</th>
<th>Steris</th>
<th>Bioquell</th>
<th>Tru-D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abbreviation</strong></td>
<td>DMHP (dry mist HP)</td>
<td>VHP (vaporized HP)</td>
<td>HPV (HP vapor)</td>
<td>UV-C</td>
</tr>
<tr>
<td><strong>Active agent</strong></td>
<td>Stenulis (5% HP, &lt;50 ppm silver cations)</td>
<td>Vaprox (35% HP)</td>
<td>35% HP</td>
<td>UV-C irradiation at 254 nm</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Aerosol of active solution</td>
<td>Vapor, noncondensing</td>
<td>Vapor, condensing</td>
<td>UV irradiation, direct and reflected</td>
</tr>
<tr>
<td><strong>Aeration (removal of active agent from enclosure)</strong></td>
<td>Passive decomposition</td>
<td>Active catalytic conversion</td>
<td>Active catalytic conversion</td>
<td>Not necessary</td>
</tr>
</tbody>
</table>

### Sporicidal efficacy
- Single cycle does not inactivate *Bacillus atrophaeus* BIs; ~4-log<sub>10</sub> reduction in *Clostridium difficile* and incomplete inactivation in situ
- Inactivation of *Geobacillus stearothermophilus* BIs
- Inactivation of *G. stearothermophilus* BIs; >6-log<sub>10</sub> reduction in *C. difficile* in vitro and complete inactivation in situ
- 1.7–4-log<sub>10</sub> reduction in *C. difficile* in situ

### Evidence of clinical impact
- None published
- None published
- Significant reduction in the incidence of *C. difficile*
- None published

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*NOTE.* Adapted from Otter and Yezi. BIs, biological indicators; VRE, vancomycin-resistant *Enterococcus.*

* All *C. difficile* experiments were done with *C. difficile* spores.
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 (36,000\(\mu\)Ws/cm\(^2\) for spore, 12,000\(\mu\)Ws/cm\(^2\) for bacteria), will power-down and audibly notify the operator
• Reduces colony counts of pathogens by >99.9% within 20 minutes
Effectiveness of UV Room Decontamination

TABLE 1. UV-C Decontamination of Formica Surfaces in Patient Rooms Experimentally Contaminated with Methicillin-Resistant *Staphylococcus aureus* (MRSA), Vancomycin-Resistant *Enterococcus* (VRE), Multidrug-Resistant (MDR) *Acinetobacter baumannii*, and *Clostridium difficile* Spores

<table>
<thead>
<tr>
<th>Organism</th>
<th>Inoculum</th>
<th>No. of samples</th>
<th>Decontamination, log₁₀ reduction, mean (95% CI)</th>
<th>No. of samples</th>
<th>Decontamination, log₁₀ reduction, mean (95% CI)</th>
<th>No. of samples</th>
<th>Decontamination, log₁₀ reduction, mean (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>4.88 log₁₀</td>
<td>50</td>
<td>3.94 (2.54–5.34)</td>
<td>10</td>
<td>4.31 (3.13–5.50)</td>
<td>40</td>
<td>3.85 (2.44–5.25)</td>
<td>.06</td>
</tr>
<tr>
<td>VRE</td>
<td>4.40 log₁₀</td>
<td>47</td>
<td>3.46 (2.16–4.81)</td>
<td>15</td>
<td>3.90 (2.99–4.81)</td>
<td>32</td>
<td>3.25 (1.97–4.62)</td>
<td>.003</td>
</tr>
<tr>
<td>MDR <em>A. baumannii</em></td>
<td>4.64 log₁₀</td>
<td>47</td>
<td>3.88 (2.59–5.16)</td>
<td>10</td>
<td>4.21 (3.27–5.15)</td>
<td>37</td>
<td>3.79 (2.47–5.10)</td>
<td>.07</td>
</tr>
<tr>
<td><em>C. difficile</em> spores</td>
<td>4.12 log₁₀</td>
<td>45</td>
<td>2.79 (1.20–4.37)</td>
<td>10</td>
<td>4.04 (3.71–4.37)</td>
<td>35</td>
<td>2.43 (1.46–3.40)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

HP SYSTEMS FOR ROOM DECONTAMINATION
HPV in vitro Efficacy

<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><em>Serratia</em></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><em>C. difficile</em></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>Shapey, 2008</td>
<td>HP dry mist</td>
<td><em>C. difficile</em></td>
<td>48/203-24%; 7</td>
<td>7/203-3%; 0.4</td>
<td>88</td>
</tr>
<tr>
<td>Barbut, 2009</td>
<td>HP dry mist</td>
<td><em>C. difficile</em></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>
Room Decontamination With VHP

- **Study design**
  - Before and after study of VHP

- **Outcome**
  - *C. difficile* incidence

- **Results**
  - VHP decreased environmental contamination with *C. difficile* (p<0.001), rates on high incidence floors from 2.28 to 1.28 cases per 1,000 pt-days (p=0.047), and throughout the hospital from 1.36 to 0.84 cases per 1,000 pt days (p=0.26)

Boyce JM, et al. ICHE 2008;29:723-729
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• Role of environment in transmission

• Evaluate the efficacy of surface disinfection (“elbow grease”)
• Evaluate the efficacy of room decontamination units-UV, HP
• Data that compares “elbow grease” vs “mechanical”
Tackling contamination of the hospital environment by methicillin-resistant Staphylococcus aureus (MRSA): a comparison between conventional terminal cleaning and hydrogen peroxide vapour decontamination

G.L. French\textsuperscript{a,*}, J.A. Otter\textsuperscript{b}, K.P. Shannon\textsuperscript{a}, N.M.T. Adams\textsuperscript{b}, D. Watling\textsuperscript{b}, M.J. Parks\textsuperscript{b}

\textsuperscript{a}Department of Infection, King's College London, St th Floor, North Wing, St Thomas' Hospital, Lambeth Palace Road, London SE1 7EH, UK
\textsuperscript{b}BIOQUELL PLC, Andover, Hampshire, UK

<table>
<thead>
<tr>
<th>Table I</th>
<th>Results of surface swabbing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total before cleaning</td>
</tr>
<tr>
<td>No. of rooms sampled</td>
<td>24\textsuperscript{b}</td>
</tr>
<tr>
<td>No. of swabs</td>
<td>359</td>
</tr>
<tr>
<td>Number yielding MRSA</td>
<td>264 (73.5)</td>
</tr>
<tr>
<td>From direct plating</td>
<td>185 (70.1)</td>
</tr>
<tr>
<td>++ Growth</td>
<td>75 (40.5)</td>
</tr>
<tr>
<td>+ Growth</td>
<td>110 (59.5)</td>
</tr>
<tr>
<td>From enrichment only</td>
<td>79 (29.9)</td>
</tr>
</tbody>
</table>

Matched denotes rooms in which adjacent sites were sampled before and after intervention. The number in parenthesis denotes the percentage.

\textsuperscript{a} Hydrogen peroxide vapour decontamination.
\textsuperscript{b} Eighteen single isolation rooms, two four-bed bays, four bathrooms.
\textsuperscript{c} Eight single isolation rooms, two four-bed bays.
\textsuperscript{d} Four single isolation rooms, two bathrooms.
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Summary: The hospital environment can sometimes harbour methicillin-resistant *Staphylococcus aureus* (MRSA) but is not generally regarded as a major source of MRSA infection. We conducted a prospective study in surgical wards of a London teaching hospital affected by MRSA, and compared the effectiveness of standard cleaning with a new method of hydrogen peroxide vapour decontamination. MRSA contamination, measured by surface swabbing was compared before and after terminal cleaning that complied with UK national standards, or hydrogen peroxide vapour decontamination. All isolation rooms, ward bays and bathrooms tested were contaminated with MRSA and several antibiogram types were identified. MRSA was common in sites that might transfer organisms to the hands of staff and was isolated from areas and bed frames used by non-MRSA patients. Seventy-four percent of 359 swabs taken before cleaning yielded MRSA, 70% by direct plating. After cleaning, all areas remained contaminated, with 66% of 124 swabs yielding MRSA, 74% by direct plating. In contrast, after exposing six rooms to hydrogen peroxide vapour, only one of 85 (1.2%) swabs yielded MRSA, by enrichment culture only. The hospital environment can become extensively contaminated with MRSA that is not eliminated by standard cleaning methods. In contrast, hydrogen peroxide vapour decontamination is a highly effective method of eradicating MRSA from rooms, furniture and equipment. Further work is needed to determine the importance of environmental contamination with MRSA and the effect on hospital infection rates of effective decontamination.
Elbow Grease vs Mechanical

• Results
  – Before cleaning -89.5% (111/124)
  – After cleaning (elbow grease)-66.1% (82/124)
  – Before HPV -71.8% (61/85)
  – After HPV (mechanical)-1.2% (1/85)
  – Environmental Disinfection: What Works Best?
  – Microbial Reduction: Elbow grease-23.4% vs Mechanical-70.6%
Comparison of the Efficacy of a Hydrogen Peroxide Dry-Mist Disinfection System and Sodium Hypochlorite Solution for Eradication of *Clostridium difficile* Spores

F. Barbut, PharmD, PhD; D. Menuet, BSc; M. Verachten, BSc; E. Girou, PharmD

OBJECTIVE. To compare a hydrogen peroxide dry-mist system and a 0.5% hypochlorite solution with respect to their ability to disinfect *Clostridium difficile*-contaminated surfaces in vitro and in situ.

DESIGN. Prospective, randomized, before-after trial.

SETTING. Two French hospitals affected by *C. difficile*.

INTERVENTION. In situ efficacy of disinfectants was assessed in rooms that had housed patients with *C. difficile* infection. A prospective study was performed at 2 hospitals that involved randomization of disinfection processes. When a patient with *C. difficile* infection was discharged, environmental contamination in the patient’s room was evaluated before and after disinfection. Environmental surfaces were sampled for *C. difficile* by use of moistened swabs; swab samples were cultured on selective plates and in broth. Both disinfectants were tested in vitro with a spore-carrier test; in this test, 2 types of material, vinyl polychloride (representative of the room’s floor) and laminate (representative of the room’s furniture), were experimentally contaminated with spores from 3 *C. difficile* strains, including the epidemic clone ribotype 027–North American pulsed-field gel electrophoresis type 1.

RESULTS. There were 748 surface samples collected (360 from rooms treated with hydrogen peroxide and 388 from rooms treated with hypochlorite). Before disinfection, 46 (24%) of 194 samples obtained in the rooms randomized to hypochlorite treatment and 34 (19%) of 180 samples obtained in the rooms randomized to hydrogen peroxide treatment showed environmental contamination. After disinfection, 23 (12%) of 194 samples from hypochlorite-treated rooms and 4 (2%) of 180 samples from hydrogen peroxide treated rooms showed environmental contamination, a decrease in contamination of 50% after hypochlorite decontamination and 91% after hydrogen peroxide decontamination (P < .005). The in vitro activity of 0.5% hypochlorite was time dependent. The mean (±SD) reduction in initial log₁₀ bacterial count was 4.32 ± 0.35 log₁₀ colony-forming units after 10 minutes of exposure to hypochlorite and 4.18 ± 0.8 log₁₀ colony-forming units after 1 cycle of hydrogen peroxide decontamination.

CONCLUSION. In situ experiments indicate that the hydrogen peroxide dry-mist disinfection system is significantly more effective than 0.5% sodium hypochlorite solution at eradicating *C. difficile* spores and might represent a new alternative for disinfecting the rooms of patients with *C. difficile* infection.
Comparison of HP and Chlorine with *C. difficile*

(Barbut et al. *Infect Control Hosp Epidemiol* 2009;30:507)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Before Treatment</th>
<th>After Treatment</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen peroxide mist</td>
<td>19% (34/180)</td>
<td>2% (2/180)</td>
<td>91% (p&lt;.005)</td>
</tr>
<tr>
<td>Chlorine</td>
<td>24% (46/194)</td>
<td>12% (23/194)</td>
<td>50%</td>
</tr>
</tbody>
</table>
EFFICACY OF HYPOCHLORITE VS HYDROGEN PEROXIDE DRY MIST

- Study design: Prospective randomized before-after study, 2007
- Setting: 2 French hospitals
- Methods: Disinfection: A=0.5% hypochlorite; B=HP-Ag cation dry-mist (Sterusil)
- Results
  - After disinfection 12% of samples from hypochlorite rooms and 2% from HP showed contamination (p<0.005)
- No measurement of cleaning thoroughness

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Environmental Disinfection: What Works Best?

Environmental-relating to the environment (conditions surrounding a person or organism)
Disinfection- destruction of pathogenic microorganisms
What -which thing
Works-operates effectively or successfully
Best -exceeding all others in excellence

MECHANICAL
71% V 23% microbial reduction
Thoroughness of Environmental Cleaning
Carling et al. ECCMID, Milan, Italy, May 2011

Mean = 32%

>110,000 Objects

DAILY CLEANING
TERMINAL CLEANING

Objects: 14 Sites, 16 Sites, 7 Sites, 7 Sites, 7 Sites, 4 Sites, 4 Sites, 9 Sites, 4 Sites
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Summary

- “Touch” techniques are ineffective when the surface is not “touched”. Studies have shown that most near patient surfaces are not being cleaned in accordance with existing policies.
- “No touch” techniques are highly effective and disinfects all surfaces (even equipment or room sites that are difficult to clean) not just surfaces that are “touched” or wiped.
- “No touch” technology supplement but do not replace surface disinfection as it does not remove soil.

**Which process operates successfully and exceeds all others in excellence- “no touch” methods such as hydrogen peroxide systems and UV**
Thank you