Sustained Antimicrobial Activity of a Novel Disinfectant Against Healthcare Pathogens

William A. Rutala, PhD, MPH, Maria F. Gergen MT (ASCP), Emily E. Sickbert-Bennett, PhD, Deverick J. Anderson, MD, MPH, and David J. Weber, MD, MPH

Hospital Epidemiology, UNC Hospitals; Division of Infectious Diseases, UNC School of Medicine, Chapel Hill, NC; and Duke Center for Antimicrobial Stewardship and Infection Prevention, Durham, NC

Disclosure: PDI
Environmental Contamination Leads to HAIs

- Evidence environment contributes
- EPI-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 Important Pathogen

- Results in the newly admitted patient having an increased risk of acquiring that previous patient’s 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
Environmental Contamination Leads to HAIs

• By contaminating hands/gloves via contact with the environment and transfer to patient, or patient self inoculation

• Surface should be hygienically clean (not sterile)-free of pathogens in sufficient numbers to prevent human disease

• Two environmental surface concerns
  ■ Discharge/terminal-new patient in room
  ■ Daily room decontamination
Environmental Contamination Leads to HAs

- By contaminating hands/gloves via contact with the environment and transfer to patient or patient self inoculation
- Surface should be hygienically clean (not sterile)-free of pathogens in sufficient numbers to prevent human disease
- Two environmental surface concerns
  - Discharge/terminal-prevent infection to new patient in room
  - Daily room decontamination
“No Touch” Approaches To Room Decontamination
(UV/VHP~20 microbicidal studies, 12 HAI reduction studies; will not discuss technology with limited data)
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.

<table>
<thead>
<tr>
<th></th>
<th>Standard Method</th>
<th>Enhanced method</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Quat</td>
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<tr>
<td>EIP (mean CFU per room)</td>
<td>60.8</td>
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<tr>
<td>Reduction (%)</td>
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  ■ Discharge/terminal-new patient in room
  ■ Daily room decontamination (referred to “trash and dash”)
Evidence That All Touchable Room Surfaces Are Equally Contaminated

<table>
<thead>
<tr>
<th>Surface (no. of samples)</th>
<th>Mean CFUs/RODAC (95% CI)</th>
<th>Precleaning</th>
<th>Postcleaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (n = 40)</td>
<td></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></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></td>
<td>56.7 (34.2–79.2)</td>
<td>5.7 (2.01–9.4)</td>
</tr>
</tbody>
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**NOTE.** CFU, colony-forming unit; CI, confidence interval.
Relationship Between Microbial Burden and HAIs

Rutala WA et al. ICHE 2018;38:1118-1121; Salgado CD, et al. ICHE 2013;34:479-86

Table 2. Relationship between microbial reduction of epidemiologically-important pathogens (EIP) and colonization/infection in a patient subsequently admitted to a room of a patient colonized/infected with an EIP by decontamination method.

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Figure 2. Quartile distribution of healthcare-acquired infections (HAIs) stratified by microbial burden measured in the intensive care unit (ICU) room during the patient’s stay. There was a significant association between burden and HAI risk \(P = .038\), with 89% of HAIs occurring among patients cared for in a room with a burden of more than 500 colony-forming units (CFUs)/100 cm².
To reduce microbial contamination

Continuous Room Decontamination Technology
Continuous Room Decontamination Technologies for Disinfection of the Healthcare Environment

- Visible light disinfection through LEDs
- Low concentration hydrogen peroxide
- Self-disinfecting surfaces
- Persistent (or continuously active) disinfectant that provides continuous disinfection action
Evaluation of a Persistent Surface Disinfectant
“EPA Protocol for Residual Self-Sanitizing Activity of Dried Chemical Residuals on Hard, Non-Porous Surfaces”

Abrasion Tester

Test Surface

Abrasion Boat
Evaluation of a Persistent Surface Disinfectant
“EPA Protocol for Residual Self-Sanitizing Activity of Dried Chemical Residuals on Hard, Non-Porous Surfaces”

- Test surface inoculated \((10^5)\), treated with test disinfectant, allowed to dry.
- Surface will undergo “wears” (abraded under alternating wet and dry conditions [24 passes, 12 cycles]) and 6 re-inoculations \((10^3, 30\text{min dry})\) over 24hr
- At the end of the study and at least 24 hours later, the ability of the test surface to kill microbes (99.9%) within 5 min is measured using the last inoculation \((10^6)\)
Evaluation of a Persistent Surface Disinfectant

“EPA Protocol for Residual Self-Sanitizing Activity of Dried Chemical Residuals on Hard, Non-Porous Surfaces”

Abrasion Tester

Abrasion Boat

Foam

Cloth

Baseplate

Weight
Evaluation of a Persistent Surface Disinfectant
Efficacy of a Persistent Surface Disinfectant
Rutala WA, Gergen M, Sickbert-Bennett E, Anderson D, Weber D. ID Week 2018

4-5 $\log_{10}$ reduction in 5min over 24hr for most pathogens; ~99% reduction with *Klebsiella* and CRE *Enterobacter*.

<table>
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<tr>
<th>Test Pathogen</th>
<th>Mean Log$_{10}$ Reduction , 95% CI n=4</th>
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<tr>
<td>S.aureus*</td>
<td>4.4 (3.9, 5.0)</td>
</tr>
<tr>
<td>S.aureus (formica)</td>
<td>4.1 (3.8, 4.4)</td>
</tr>
<tr>
<td>S.aureus (stainless steel)</td>
<td>5.5 (5.2, 5.9)</td>
</tr>
<tr>
<td>VRE</td>
<td>≥4.5</td>
</tr>
<tr>
<td><em>E.coli</em></td>
<td>4.8 (4.6, 5.0)</td>
</tr>
<tr>
<td><em>Enterobacter</em> sp.</td>
<td>4.1 (3.5, 4.6)</td>
</tr>
<tr>
<td><em>Candida auris</em></td>
<td>≥5.0</td>
</tr>
<tr>
<td><em>K pneumoniae</em></td>
<td>1.5 (1.4, 1.6)</td>
</tr>
<tr>
<td>CRE <em>E.coli</em></td>
<td>3.0 (2.6, 3.4)</td>
</tr>
<tr>
<td>CRE <em>Enterobacter</em></td>
<td>2.0 (1.6, 2.4)</td>
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<tr>
<td>CRE <em>K pneumoniae</em></td>
<td>2.1 (1.8, 2.4)</td>
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*Test surface glass unless otherwise specified*
When the novel disinfectant was compared to three other commonly used disinfectants using the same methodology with *S. aureus*, the mean log\(_{10}\) reductions were: 4.4 (novel disinfectant); 0.9 (quat-alcohol); 0.2 (improved hydrogen peroxide); and 0.1 (chlorine).
Efficacy of a Persistent (Continuously Active) Surface Disinfectant

Summary

• Preliminary studies with a new continuously active disinfectant are promising (e.g., 4-5 log_{10} reduction in 5min over 24hr)

• Unclear why 99% reduction with *Klebsiella* and CRE *Enterobacter*; most surfaces have <100 CFU/Rodac

• Continuously active disinfectants may reduce or eliminate the problem of recontamination.
THANK YOU!
www.disinfectionandsterilization.org