Best Practices in Disinfection of Noncritical Surfaces in the Healthcare Setting

William A. Rutala, Ph.D., M.P.H.
Director, Statewide Program for Infection Control and Epidemiology and Research Professor of Medicine, University of North Carolina at Chapel Hill, NC, USA

Former Director, Hospital Epidemiology, Occupational Health and Safety, UNC Health Care, Chapel Hill, NC (1979-2017)
DISCLOSURES
2017-2018

• Consultations
  ▪ ASP (Advanced Sterilization Products), PDI

• Honoraria
  ▪ PDI, Kennall

• Scientific Advisory Board
  ▪ Kinnos

• Grants
  ▪ CDC, CMS
Disinfection of Noncritical Surfaces Bundle

- Develop policies and procedures
- Select cleaning and disinfecting products
- Educate staff to environmental services and nursing
- Monitor compliance (thoroughness of cleaning, product use) and feedback
- Implement “no touch” room decontamination technology and monitor compliance
Environmental Contamination Leads to HAI's

- 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%)
Institute Practices that Prevent All Infectious Disease Transmission via Environment
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NL Havill AJIC 2013;41:S26-30
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
Blood Pressure Cuff
Non-Critical Patient Care Item
• 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.

**FIGURE 1.** Effect of daily disinfection of high-touch environmental surfaces on acquisition of *Clostridium difficile* and methicillin-resistant *Staphylococcus aureus* (MRSA) on gloved hands of investigators after contact with the surfaces. A. Percentage of positive *C. difficile* cultures; B, mean number of *C. difficile* colony-forming units acquired; C, percentage of positive MRSA cultures; D, mean number of MRSA colony-forming units acquired.
EVIDENCE THAT ALL TOUCHABLE ROOM SURFACES ARE EQUALLY CONTAMINATED


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)
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
  - 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).
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Effective Surface Decontamination

Product and Practice = Perfection
## Low-Level Disinfection for Noncritical Equipment and Surfaces


**Exposure time ≥ 1 min**

<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>Peracetic acid with HP (<em>C. difficile</em>)</td>
<td>UD</td>
</tr>
</tbody>
</table>

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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)
Microbiological Disinfectant Hierarchy
Rutala WA, Weber DJ, HICPAC. www.cdc.gov

Most Resistant

- **Spores** (*C. difficile*)
- **Mycobacteria** (*M. tuberculosis*)
- **Non-Enveloped Viruses** (norovirus, HAV, polio)
- **Fungi** (*Candida, Trichophyton*)
- **Bacteria** (MRSA, VRE, *Acinetobacter*)
- **Enveloped Viruses** (HIV, HSV, Flu)

Most Susceptible
MOST PREVALENT PATHOGENS CAUSING HAI

Most prevent 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
TABLE 2
Disinfectant Activity Against Antibiotic-Susceptible and Antibiotic-Resistant Bacteria

<table>
<thead>
<tr>
<th>Product</th>
<th>VSE 0.5 min</th>
<th>VSE 5 min</th>
<th>VRE 0.5 min</th>
<th>VRE 5 min</th>
<th>MSSA 0.5 min</th>
<th>MSSA 5 min</th>
<th>MRSA 0.5 min</th>
<th>MRSA 5 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesphene Ilse</td>
<td>&gt;4.3</td>
<td>&gt;4.3</td>
<td>&gt;4.8</td>
<td>&gt;4.8</td>
<td>&gt;5.1</td>
<td>&gt;5.1</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Clorox</td>
<td>&gt;5.4</td>
<td>&gt;5.4</td>
<td>&gt;4.9</td>
<td>&gt;4.9</td>
<td>&gt;5.0</td>
<td>&gt;5.0</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Lysol Disinfectant</td>
<td>&gt;4.3</td>
<td>&gt;4.3</td>
<td>&gt;4.8</td>
<td>&gt;4.8</td>
<td>&gt;5.1</td>
<td>&gt;5.1</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Lysol Antibacterial</td>
<td>&gt;5.5</td>
<td>&gt;5.5</td>
<td>&gt;5.5</td>
<td>&gt;5.5</td>
<td>&gt;5.1</td>
<td>&gt;5.1</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Vinegar</td>
<td>0.1</td>
<td>5.3</td>
<td>1.0</td>
<td>3.7</td>
<td>+1.1</td>
<td>+0.9</td>
<td>+0.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Abbreviations: MRSA, methicillin-resistant Staphylococcus aureus; MSSA, methicillin-susceptible S. aureus; VRE, vancomycin-resistant Enterococcus; VSE, vancomycin-susceptible Enterococcus.

Data represent mean of two trials (n=2). Values preceded by "*>" represent the limit of detection of the assay. Assays were conducted at a temperature of 20°C and a relative humidity of 45%. Results were calculated as the log of Nd/No, where Nd is the titer of bacteria surviving after exposure and No is the titer of the control.
The term “wetness” is controversial. Based on EPA test, treatment time is the kill time and includes a wet time via wiping as well as the undisturbed time. Duration of wet time is not relevant.
## Risk Assessment Worksheet

### Issue:
Off-label use for undisturbed time after environmental disinfection

### Assessment Date:
March 5, 2018

### Scoring:
- Low = 1
- Moderate = 3
- High = 5

### Team Members:

### Meeting Actions:
Team members evaluated the evidence and determined that off-label use of undisturbed time was sufficient to disinfect noncritical environmental surfaces and noncritical patient care equipment in a healthcare environment.

<table>
<thead>
<tr>
<th>Suggested Questions</th>
<th>Benefit</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the truth about disinfectant contact time?</td>
<td>Most manufacturers suggest the user maintain wetness for the duration of the contact time. The method used to assess efficacy of disinfectant wipes by the EPA is the Disinfectant Towelette Test. The procedure involves using one towelette to wipe ten carriers/slides. The area of the towelette used for wiping is folded and rotated so as to expose a new surface of the towelette for each carrier. To generate test cultures, carriers are inoculated using pathogens <em>Staphylococcus aureus, Pseudomonas aeruginosa, and Salmonella enterit.</em> The test procedure involves wiping the slide back and forth for a total of six passes across the inocula for 15 seconds of</td>
<td>There is no risk to utilizing a treatment time instead of a wet time for the given contact time of a disinfectant. Score = 1</td>
</tr>
</tbody>
</table>
Some cloths can bind Quat disinfectants resulting in decreased Quat delivery to the surface.

When pre-moistened wipes tested, each wipe is tested for active content from the expressed liquid. Thus, any binding that may occur with the applicator is taken into account.
Surface roughness can play a role in cleanability and bacteria and soil can adhere differently—significance?

Fig 1. Polypropylene (PPE) and ultra-high-molecular-weight polyethylene (UHMWPE) smooth and rough coupons were spotted with Bacillus atrophaeus spores alone or spores with blood test soil. Coupons were not cleaned or cleaned with gauze soaked in water, ethanol, or bleach. The data were normalized to the positive (no wipe) controls, which were set as 100%. b, bacteria; b&x, bacteria plus soil.
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Product and Practice = Perfection
Thoroughness of Environmental Cleaning
Carling et al. ECCMID, Milan, Italy, May 2011

Mean = 32%

DAILY CLEANING
TERMINAL CLEANING

>110,000 Objects

% Cleaned

100
90
80
70
60
50
40
30
20
10
0

HEHS HOSP
IOWA HOSP
OTHER HOSP
OPERATING ROOMS
NICU
EMS VEHICLES
ICU DAILY
AMB CHEMO
MD CLINIC
LONG TERM
DIALYSIS

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

Mean = 32%

= 95% CI
Practice* NOT Product

*surfaces not wiped
Thoroughness of Environmental Cleaning


Hospitals can improve their thoroughness of terminal room disinfection through fluorescent monitoring.

![Bar chart showing the thoroughness of disinfection cleaning across different hospitals.](chart.png)

**Figure 4.** A comparison of the results of the 3 previously published multisite studies compared with results from the Iowa project. White bars represent the average baseline TDCs and black bars represent the average final TDCs for sites that completed each study.
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)
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.
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
• Increased visibility when disinfecting surfaces, fewer missed spots
• Real-time quality control that allows staff to monitor thoroughness of cleaning
By improving thoroughness will it reduce microbial contamination and reduce transmission?
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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


<table>
<thead>
<tr>
<th></th>
<th>Standard Method</th>
<th>Enhanced Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quat</td>
<td>Quat/UV</td>
</tr>
<tr>
<td>EIP (mean CFU per room)</td>
<td>60.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Reduction (%)</td>
<td></td>
<td>94</td>
</tr>
<tr>
<td>Colonization/Infection (rate)</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Reduction (%)</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Bleach</td>
<td>Bleach/UV</td>
</tr>
<tr>
<td>EIP (mean CFU per room)</td>
<td>11.7</td>
<td>6.3</td>
</tr>
<tr>
<td>Reduction (%)</td>
<td>81</td>
<td>90</td>
</tr>
<tr>
<td>Colonization/Infection (rate)</td>
<td>1.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Reduction (%)</td>
<td>17</td>
<td>4</td>
</tr>
</tbody>
</table>

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).
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Our Responsibility to the Future

Institute Practices that Prevent All Infectious Disease Transmission via Environment
How Will We Prevent Infections Associated with the Environment?

• Implement evidence-based practices for surface disinfection
  - 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

• Use new continuous room decontamination technology that continuously reduces microbial contamination
THANK YOU!
www.disinfectionandsterilization.org