Best Practices in Disinfection of Noncritical Surfaces in the Healthcare Setting: A Bundle Approach

William A. Rutala, Ph.D., M.P.H., C.I.C.
Director, Statewide Program for Infection Control and Epidemiology and 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

2020-2021

- Consultations
  - PDI (Professional Disposable International)
- Honoraria
  - PDI

This presentation sponsored by Alkamedica
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 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>Site</th>
<th>Estimated Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor</td>
<td>34.5%</td>
</tr>
<tr>
<td>Bed linen</td>
<td>41%</td>
</tr>
<tr>
<td>Patient gown</td>
<td>40.5%</td>
</tr>
<tr>
<td>Overbed table</td>
<td>40%</td>
</tr>
<tr>
<td>Blood pressure cuff</td>
<td>21%</td>
</tr>
<tr>
<td>Bed or siderails</td>
<td>27%</td>
</tr>
<tr>
<td>Bathroom door handle</td>
<td>14%</td>
</tr>
<tr>
<td>Infusion pump button</td>
<td>19%</td>
</tr>
<tr>
<td>Room door handle</td>
<td>21.5%</td>
</tr>
<tr>
<td>Furniture</td>
<td>27%</td>
</tr>
<tr>
<td>Flat surfaces</td>
<td>21.5%</td>
</tr>
<tr>
<td>Sink taps or basin fitting</td>
<td>23.5%</td>
</tr>
<tr>
<td>Average quoted</td>
<td>37%</td>
</tr>
</tbody>
</table>

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

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

Curtis J. Donskey MD a,b,*

aGeriatric Research, Education, and Clinical Center, Cleveland Veterans Affairs Medical Center, Cleveland, OH
bCase Western Reserve University School of Medicine, Cleveland, OH

Key Words
- Environment
- Cleaning
- Transmission

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.

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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
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

• 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
• Disinfecting Noncritical Patient-Care Items
  
  - Process noncritical patient-care equipment with a 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*
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.

**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.
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 $\geq 80\%$, 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
**TABLE 1.** Pre-cleaning and Post-cleaning Bacterial Load Measurements for High-, Medium-, and Low-Touch Surfaces

<table>
<thead>
<tr>
<th>Surface (no. of samples)</th>
<th>Pre-cleaning</th>
<th>Post-cleaning</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.

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**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.
Disinfection of Noncritical Surfaces Bundle

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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
<table>
<thead>
<tr>
<th>Technique (with cotton)</th>
<th>MRSA Log\textsubscript{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
  ■ 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
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
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

LLD
**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>PA with HP, HP, chlorine (<em>C. difficile</em>)</td>
<td>UD</td>
</tr>
</tbody>
</table>

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
• 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
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• Develop policies and procedures
  ◼ Standardize C/D patient rooms and pieces of equipment throughout the hospital
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  ◼ 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).
• 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

- 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

Mean = 32%

>110,000 Objects
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)
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
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.
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 (and new strategies)
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)(^a)</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)(^b)</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Reduction (%)</td>
<td></td>
<td>35</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).
New Strategies in Cleaning and Disinfection

- Wipes, disinfectant contact time
- Inactivation of *C. auris*, CRE, SARS-CoV-2
- UV
- Continuous room decontamination
Advantages
• Avoids improper dilution
• Avoids human errors (double dip)
• Ratio of disinfectant-wipe standard
• Lower risk of contamination
• Effectively removes microbial contaminants
• Greater compliance by environmental service personnel
• Lower employee time costs
• No laundering

Disadvantages
• Inappropriate disposal into toilets
• Potential environmental impact
• Storage area needed
• Supply costs
Disinfectant Kill Time
Rutala, Weber. AJIC. 2019

• Each chemical disinfectant requires a specific length of time it must remain in contact with a microorganism to achieve complete inactivation.

• This is known as the “kill time” (or “contact time”) and the registered kill times for each microorganism will be clearly listed.

• There are only two papers in the peer-review literature that assessed EPA-registered disinfectants that are directly on point to the question will hospital disinfectants kill hospital pathogens in 1 minute.
Germicidal Activity against Carbapenem/Colistin-Resistant *Enterobacteriaceae* Using a Quantitative Carrier Test Method

Hajime Kanamori,a,b William A. Rutala,a,b Maria F. Gergen,a Emily E. Sickbert-Bennett,a,b David J. Webera,b

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*Department of Hospital Epidemiology, University of North Carolina Health Care, Chapel Hill, North Carolina, USA*

*Division of Infectious Diseases, University of North Carolina School of Medicine, Chapel Hill, North Carolina, USA*

**ABSTRACT** Susceptibility to germicides for carbapenem/colistin-resistant *Enterobacteriaceae* is poorly described. We investigated the efficacy of multiple germicides against these emerging antibiotic-resistant pathogens using the disc-based quantitative carrier test method that can produce results more similar to those encountered in health care settings than a suspension test. Our study results demonstrated that germicides commonly used in health care facilities likely will be effective against carbapenem/colistin-resistant *Enterobacteriaceae* when used appropriately in health care facilities.

**KEYWORDS** carbapenem-resistant *Enterobacteriaceae*, *Klebsiella pneumoniae* carbapenemase, colistin-resistant *Enterobacteriaceae*, *mcr-1*, germicides, disinfectants, antiseptics, efficacy
Efficacy of Disinfectants and Antiseptics against Carbapenem-Resistant *Enterobacteriaceae*


- $\geq 3 \log_{10}$ reduction (CRE, 1m, 5% FCS, QCT)
  - 0.20% peracetic acid
  - 2.4% glutaraldehyde
  - 0.5% Quat, 55% isopropyl alcohol
  - 58% ethanol, 0.1% QUAT
  - 28.7% isopropyl alcohol, 27.3% ethyl alcohol, 0.61% QAC
  - 0.07% o-phenylphenol, 0.06% p-tertiary amylphenol
  - ~5,250 ppm chlorine
  - 70% isopropyl alcohol
  - Ethanol hand rub (70% ethanol)
  - 0.65% hydrogen peroxide, 0.15% peroxyacetic acid
  - Accelerated hydrogen peroxide, 1.4% and 2.0%
  - Quat, (0.085% QACs; not *K. pneumoniae*)
Candida auris is a globally emerging pathogen that is often resistant to multiple antifungal agents.

In several reports, C. auris has been recovered from the hospital environment.

CDC has recommended daily and post-discharge disinfection of surfaces in rooms of patients with C. auris infection.

No hospital disinfectants are registered for use specifically against C. auris, and its susceptibility to germicides is not known.
Efficacy of Disinfectants and Antiseptics against *Candida auris*
Rutala, Kanamori, Gergen, Sickbert-Bennett, Weber, ICHE 2019

- ≥3 log$_{10}$ reduction (*C. auris*, 1m, 5% FCS, QCT)
  - 0.20% peracetic acid
  - 2.4% glutaraldehyde
  - 0.65% hydrogen peroxide, 0.14% per oxyacetic acid
  - 0.5% Quat, 55% isopropyl alcohol
  - Disinfecting spray (58% ethanol, 0.1% QUAT)
  - 28.7% isopropyl alcohol, 27.3% ethyl alcohol, 0.61% QAC
  - 0.07% o-phenylphenol, 0.06% p-tertiary amylphenol
  - 70% isopropyl alcohol
  - ~5,250 ppm chlorine
  - Ethanol hand rub (70% ethanol)
  - Accelerated hydrogen peroxide, 1.4%
  - Accelerated hydrogen peroxide, 2%
Efficacy of Disinfectants and Antiseptics against *Candida auris*

Rutala, Kanamori, Gergen, Sickbert-Bennett, Weber, ICHE 2019

- $\leq 3 \log_{10}$ (most $< 2 \log_{10}$) reduction (*C. auris*, 1m, 5% FCS, QCT)
  - 0.55% OPA
  - 3% hydrogen peroxide
  - Quat, (0.085% QACs)
  - 10% povidone-iodine
  - ~1,050 ppm chlorine
  - 2% Chlorhexidine gluconate-CHG
  - 4% CHG
  - 0.5% triclosan
  - 1% CHG, 61% ethyl alcohol
  - 1% chloroxylenol
# Role of Healthcare Surface Environment in SARS-CoV-2 Transmission

*Kanamori, Weber, Rutala, Clin Infect Dis, In press*

<table>
<thead>
<tr>
<th>SARS-CoV-2 RNA</th>
<th>Bed rail</th>
<th>Sink</th>
<th>BP monitor</th>
<th>Infusion pump</th>
<th>Keyboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedside table</td>
<td>Floor</td>
<td>ECG monitor</td>
<td>Fluid stand</td>
<td>Phone</td>
<td></td>
</tr>
<tr>
<td>Chair</td>
<td>Toilet seat</td>
<td>Oxygen regulator</td>
<td>Hand sanitizer</td>
<td>Computer mouse</td>
<td></td>
</tr>
<tr>
<td>Doorknob</td>
<td>Toilet bowl</td>
<td>Oxygen mask</td>
<td>Trash can</td>
<td>Door</td>
<td></td>
</tr>
<tr>
<td>Light switches</td>
<td>Stethoscope</td>
<td>CT scanner</td>
<td>Self-service printer</td>
<td>Glass window</td>
<td></td>
</tr>
<tr>
<td>Call button</td>
<td>Pulse oximetry</td>
<td>Ventilator</td>
<td>Desktop</td>
<td>PPE storage area</td>
<td></td>
</tr>
<tr>
<td>Centrifuge</td>
<td>Biosafety cabinet</td>
<td>Infant bed</td>
<td>Air outlet</td>
<td>Ambu bag</td>
<td></td>
</tr>
<tr>
<td>TV remote</td>
<td>Bed sheet</td>
<td>Urinary catheters</td>
<td>TV</td>
<td>Beepers</td>
<td></td>
</tr>
<tr>
<td>Elevator buttons</td>
<td>Ventilator tubing</td>
<td>Glove boxes</td>
<td>Touch screen</td>
<td>All surfaces in nurse’s station</td>
<td></td>
</tr>
</tbody>
</table>
Pt 1 and 2-2/48-4% (closed suction to ventilator) pt 3-13/28-46% (high-flow oxygen therapy via nasal cannula, non-invasive ventilation). Found viable virus (7/28-25%) only on surfaces within droplet distance (bedside table, remote control, bed rails, bedsheets, mask, nasal prongs, floor near patient). All air samples negative.
Decreasing Order of Resistance of Microorganisms to Disinfectants/Sterilants

• CDC recommends that an EPA-registered disinfectant on the EPA’s List N that has qualified under the emerging pathogen program for use against SARS-CoV-2 be chosen for the COVID-19 patient care.

• List N has >500 entries and 32 different active ingredients (Quats, chlorine, etc)
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
THANK YOU!

www.disinfectionandsterilization.org