*Infection Control & Hospital Epidemiology* (2023), **44**, 837–839
doi:10.1017/ice.2022.73

SHEA

## Concise Communication

# Effectiveness of a novel 1-step cleaner and disinfectant against *Candida auris*

Muhammed F. Haq MD[1], Jennifer L. Cadnum BS[1], Basya S. Pearlmutter BS[1], Annette L. Jencson CIC[1] and Curtis J. Donskey MD[2,3]

[1]Research Service, Louis Stokes Cleveland VA Medical Center, Cleveland, Ohio, [2]Geriatric Research, Education and Clinical Center, Louis Stokes Cleveland VA Medical Center, Cleveland, Ohio and [3]Case Western Reserve University School of Medicine, Cleveland, Ohio

**Abstract**

A novel 1-step anionic surfactant disinfectant was effective against *Candida auris* isolates from the 4 major phylogenetic clades as well as methicillin-resistant *Staphylococcus aureus* (MRSA) and the enveloped virus bacteriophage Phi6. This anionic surfactant disinfectant may be a useful addition to the disinfectant products available for use against *C. auris*.

(Received 26 January 2022; accepted 2 March 2022; electronically published 28 March 2022)

*Candida auris* is an emerging fungal pathogen that can be transmitted via contaminated surfaces.[1–3] To reduce the risk for transmission, the Centers for Disease Control and Prevention (CDC) recommends thorough cleaning and disinfection of surfaces and equipment in patient rooms and other care areas using disinfectants effective against *C. auris*.[1] Unfortunately, disinfectants, which are effective against *C. auris* (eg, sodium hypochlorite, improved hydrogen peroxide, peracetic acid-based products) often have disadvantages such as high cost, adverse effects on surfaces, or reduced stability.[4] Many healthcare facilities use quaternary ammonium disinfectants that have relatively limited activity against *C. auris*.[5] Thus, new disinfectants with activity against *C. auris* are needed.

Disinfectant 1 (active ingredient dodecylbenzene sulfonic acid) is a recently developed 1-step anionic surfactant disinfectant available as a spray or wipe. According to the manufacturer, the product has good materials compatibility, and no personal protective equipment is required for routine cleaning and disinfection. Disinfectant 1 does not have activity against *Clostridioides difficile* spores, but it has a 1-minute Environmental Protection Agency (EPA)–registered claim against many gram-positive and gram-negative bacteria and enveloped and nonenveloped viruses, including severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and a 75-second claim against *C. auris*. However, recent studies suggest that *C. auris* isolates from clades III and/or IV might have reduced susceptibility to low concentrations of sodium hypochlorite and ultraviolet-C light in comparison to the clade II isolate Antibiotic Resistance Bank (AR) 0381, which is recommended for standard testing.[6–8] In the current study, we evaluated the effectiveness of disinfectant 1 against *C. auris* isolates from the 4 major phylogenetic clades in comparison to several other commonly used disinfectants, including quaternary ammonium, quaternary ammonium alcohol, and improved hydrogen peroxide products. For comparison, we examined the effectiveness of the disinfectants against the enveloped virus bacteriophage Phi6 and methicillin-resistant *Staphylococcus auris* (MRSA). In addition, several healthcare or environmental services personnel used disinfectant 1 wipes and 2 comparator wipe products in a standardized manner and completed a survey regarding their opinions on odor, ocular or nasal irritation, residue, contact time, and cleaning ability.

## Methods

We tested the following disinfectants: disinfectant 1 (Ecolab, Inc., St. Paul, MN), Oxivir TB wipes (Diversey, Fort Mill, SC), Virex II 256 (Diversey), Lysol All-Purpose Cleaner (Reckitt, Parsippany, NJ), Super Sani Cloth (PDI, Woodcliff Lake, NJ), and CaviCide wipes (Metrex, Romulus, MI). Of these disinfectants, only Disinfectant 1, Oxivir TB, and Super Sani Cloth have an EPA-registered claim against *C. auris*. Virex II 256 has an EPA-registered fungal claim based on efficacy against *C. albicans* or *Trichophyton mentagrophytes*. The *C. auris* test strains included AR-0381 (clade II, East Asian origin), AR-0389 (clade I, South Asian origin), AR-0383 (clade III, African origin), and AR-0385 (clade IV, South American origin). The MRSA test strain was a clinical isolate of pulsed-field gel electrophoresis type USA800. Bacteriophage Phi6 was propagated in *Pseudomonas syringae*.[7] For *C. auris*, the method recommended by the EPA for testing liquid disinfectants against *C. auris* (EPA MLB SOP MB-35-00) was used.[8] For MRSA and bacteriophage Phi6, the American Society for Testing and Materials (ASTM) standard quantitative carrier disk test method (ASTM E2197-02) was used.[9] For the wipe products, liquid expressed from the wipe was used for testing.

**Author for correspondence:** Curtis J. Donskey, MD, Geriatric Research, Education and Clinical Center, Cleveland VA Medical Center, 10701 East Boulevard, Cleveland, Ohio 44106, E-mail: Curtis.Donskey@va.gov

**Cite this article:** Haq MF, *et al.* (2023). Effectiveness of a novel 1-step cleaner and disinfectant against *Candida auris*. *Infection Control & Hospital Epidemiology*, 44: 837–839, https://doi.org/10.1017/ice.2022.73

**Table 1.** Mean (SE) $Log_{10}$ Reductions in Healthcare-Associated Pathogens Using a Quantitative Carrier Test With a 1-Minute Exposure Time

| | | $Log_{10}$ Reduction, Mean (SE) | | | | | |
|---|---|---|---|---|---|---|---|
| Disinfectant | Ingredients | MRSA | *C. auris* Clade I | *C. auris* Clade II | *C. auris* Clade III | *C. auris* Clade IV | Bacteriophage Phi6 |
| Oxivir TB wipes* | Hydrogen peroxide 0.5% | 5.35 (0.49) | 5.64 (0.0) | 5.20 (0.0) | 5.74 (0.0) | 4.78 (0.0) | >6 (0.0) |
| Virex II 256 | Didecyl dimethyl ammonium chloride 8.7%, n-alkyl dimethyl benzyl ammonium chloride 8.2% | 3.51 (0.70) | 0.04 (0.12) | 1.51 (0.86) | 0.74 (0.74) | 0.31 (0.24) | >6 (0.0) |
| Lysol all-purpose cleaner | Alkyl (50% C14, 40% C12, 10% C16) dimethyl benzyl ammonium chlorides 1.19% | 2.95 (0.17) | 1.80 (0.17) | 5.20 (0.0) | 2.18 (0.14) | 2.31 (0.09) | >6 (0.0) |
| Super Sani Cloth* | n-Alkyl (68% $C_{12}$, 32% $C_{14}$) dimethyl ethylbenzyl ammonium chlorides .25%, n-Alkyl (60% $C_{14}$, 30% $C_{16}$, 5% $C_{12}$, 5% $C_{18}$) dimethyl benzyl ammonium chlorides .25%, Isopropyl alcohol 55% | 4.52 (0.79) | 5.64 (0.0) | 5.20 (0.0) | 5.74 (0.0) | 4.22 (0.55) | >6 (0.0) |
| CaviCide wipes[a] | Di-isobutylphenoxyethoxyethyl dimethyl benzyl ammonium chloride .28%, isopropanol 17.2% | 5.13 (1.45) | 2.47 (0.44) | 5.20 (0.0) | 3.36 (0.30) | 4.08 (0.22) | >6 (0.0) |
| Disinfectant 1 spray | Dodecylbenzenesulfonic acid 0.29% | 5.36 (0.49) | 5.64 (0.0) | 5.20 (0.0) | 4.97 (0.12) | 4.78 (0.0) | >6 (0.0) |

Note. SE, standard error; MRSA, methicillin-resistant *Staphylococcus aureus*.
[a]For the wipe products liquid expressed from the wipe was used for testing.

The disinfectant contact time was 1 minute, and 5% fetal calf serum was used as a soil load. Testing was completed in triplicate. $Log_{10}$ colony-forming unit (CFU) or plaque-forming unit (PFU) reductions were calculated by comparing recovery from treated versus untreated control carriers. A 3-$log_{10}$ reduction with a 1-minute exposure time was considered adequate for clinical effectiveness.[10] The 1-minute exposure time was chosen because longer exposure times may be unrealistic in clinical settings.[10]

To assess the drying time of the disinfectants, we conducted blinded observations of visible wetness at 30, 60, and 90 seconds after application with wipes on steel and formica surfaces. To assess acceptance of disinfectant 1, 8 healthcare or environmental services personnel used disinfectant 1, Oxivir TB, and Super Sani Cloth wipes in a standardized manner. The standardized protocol included wiping 0.9×0.9-m sections of a bedside tabletop and a countertop with each of the disinfectant wipes; 1 mL of fetal calf serum was inoculated onto the middle sections of the surfaces, spread to cover 3×3 cm, and allowed to air dry leaving visible soiling of the surface. After use of each product, personnel completed a Likert-scale survey regarding their opinions on odor, ocular or nasal irritation, residue, contact time (ie, providing wet contact time for at least 1 minute was considered adequate), and cleaning ability as indicated by ability to remove the dried fetal calf serum.

## Results

Table 1 shows the ingredients of the disinfectants and the mean $log_{10}$ reductions in the test organisms with 1-minute exposure time. All the disinfectants except Virex II 256 reduced the clade II (East Asian origin) *C. auris* test strain (AR-0381) by >3 $log_{10}$. However, only disinfectant 1, Oxivir TB, and Super Sani Cloth reduced all 4 *C. auris* strains by >3 $log_{10}$. All the disinfectants reduced bacteriophage Phi6 by >3 $log_{10}$, and all except Lysol All-Purpose Cleaner reduced the MRSA test strain by >3 $log_{10}$.

For Disinfectant 1, Oxivir TB, and Super Sani Cloth, the odor was considered neutral or agreeable by 7 personnel (87.5%), 8 personnel (100%), and 6 personnel (75%), respectively. None of products caused nasal or ocular irritation and none left a residue on the surfaces. All of the products were considered to have good or superior cleaning ability based on complete removal of fetal calf serum dried on surfaces. For all participants, disinfectant 1 and Oxivir TB were considered to have average or superior contact time providing wet contact time for at least 1 minute. Of the 8, 3 (37.5%) were graded Super Sani Cloth as poor for wet contact time and partial drying of the surfaces was noted within 1 minute.

## Discussion

Disinfectant 1, Oxivir TB, and Super Sani Cloth were effective against *C. auris* isolates from the 4 major phylogenetic clades, but Virex II 256, Lysol All-Purpose Cleaner, and CaviCide were not. These findings are consistent with previous reports that improved hydrogen peroxide and some quaternary ammonium-alcohol disinfectants can be effective against *C. auris*, whereas quaternary ammonium disinfectants are not. Our results suggest that disinfectant 1 provides an additional effective option against *C. auris*.

Disinfectant 1 has potential advantages over some other disinfectants effective against *C. auris*. According to the manufacturer, disinfectant 1 has relatively good materials compatibility, including on soft surfaces. The disinfectant has a long shelf life and is ready to use with no requirement for dilution of a concentrate. It has rapid activity in comparison to many disinfectants, particularly quaternary ammonium disinfectants. Finally, all users of disinfectant 1 considered the product to have average or superior contact time providing wet contact time for at least 1 minute.

In summary, a novel 1-step anionic surfactant disinfectant was effective against isolates of *C. auris* from the 4 major phylogenetic clades with a 1-minute exposure time. The product provides healthcare facilities with an additional option against *C. auris*. Further studies are needed to evaluate the effectiveness and materials compatibility of the disinfectant in healthcare settings.

**Acknowledgments.** We thank the Environmental Services personnel at the Cleveland VA Medical Center for their assistance in conducting a trial of disinfectant 1.

https://doi.org/10.1017/ice.2022.73 Published online by Cambridge University Press

**Conflicts of interest.** C.J.D. has received research grants from Clorox, Pfizer, and PDI. All other authors report no conflicts of interest relevant to this article.

**Financial support.** This work was supported by a grant from Ecolab to C.J.D.

## References

1. Fungal diseases: *Candida auris*. Centers for Disease Control and Prevention website. https://www.cdc.gov/fungal/diseases/candidiasis/candida-auris.html. Accessed June 16, 2021.
2. Piedrahita CT, Cadnum JL, Jencson AL, Shaikh AA, Ghannoum MA, Donskey CJ. Environmental surfaces in healthcare facilities are a potential source for transmission of *Candida auris* and other *Candida* species. *Infect Control Hosp Epidemiol* 2017;38:1107–1109.
3. Pacilli M, Kerins JL, Clegg WJ, *et al.* Regional emergence of *Candida auris* in Chicago and lessons learned from intensive follow-up at 1 ventilator-capable skilled nursing facility. *Clin Infect Dis* 2020;71:e718–e725.
4. Cadnum JL, Jencson AL, O'Donnell MC, Flannery ER, Nerandzic MM, Donskey CJ. An increase in healthcare-associated *Clostridium difficile* infection associated with use of a defective peracetic acid-based surface disinfectant. *Infect Control Hosp Epidemiol* 2017;38:300–305.
5. Cadnum JL, Shaikh AA, Piedrahita CT, *et al.* Effectiveness of disinfectants against *Candida auris* and other *Candida* species. *Infect Control Hosp Epidemiol* 2017;38:1240–1243.
6. Sexton DJ, Welsh RM, Bentz ML, Forsberg K, Jackson B, Berkow EL, Litvintseva AP. Evaluation of nine surface disinfectants against *Candida auris* using a quantitative disk carrier method: EPA SOP-MB-35. *Infect Control Hosp Epidemiol* 2020;41:1219–1221.
7. Pearlmutter BS, Haq MF, Cadnum JL, Jencson AL, Carlisle M, Donskey. Efficacy of relatively low-cost ultraviolet-C light devices against *Candida auris. Infect Control Hosp Epidemiol* 2021. doi: 10.1017/ice.2021.206.
8. EPA MLB SOP MB-35-00: OECD Quantitative method for evaluating the efficacy of liquid antimicrobials against *Candida auris* on hard, non-porous surfaces. US Environmental Protection Agency Office of Pesticide Programs website. https://www.epa.gov/pesticide-registration/interim-guidance-efficacy-evaluationproducts-claims-against-candida-auris-0. Accessed June 16, 2021.
9. ASTM International, Designation E2197: standard quantitative disk carrier test method for determining bactericidal, virucidal, fungicidal, mycobactericidal, and sporicidal activities of chemicals. West Conshohocken, PA: ASTM International; 2011.
10. Rutala WA, Kanamori H, Gergen MF, Sickbert-Bennett EE, Weber DJ. Susceptibility of *Candida auris* and *Candida albicans* to 21 germicides used in healthcare facilities. *Infect Control Hosp Epidemiol* 2019;40:380–382.