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Concise Communication

A novel sink drain cover prevents dispersal of microorganisms from contaminated sink drains

Scott H. Livingston BS[1,2], Jennifer L. Cadnum BS[2], Scott Gestrich MD[2], Annette L. Jencson BS, CIC[2] and Curtis J. Donskey MD[1,3]

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

Abstract

In hospital sinks, a novel plastic drain cover was effective in preventing dispersal of gram-negative bacilli and fluorescent gel associated with splattering of flowing water. Our findings suggest that the sink drain covers could provide a simple means to reduce dissemination of pathogens from contaminated sinks.

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Sinks in healthcare facilities are an important reservoir for dissemination of multidrug-resistant gram-negative bacilli.[1–5] Unfortunately, addressing sink contamination is challenging because sink drains provide a favorable environment for pathogen colonization and biofilm formation, but they are not amenable to cleaning and disinfection. For example, sinks in healthcare facilities typically have fixed, narrow strainer holes that do not permit access by brushes that could be used to remove bioburden prior to application of disinfectants. Pouring disinfectants into sink drains has often had only modest efficacy in reducing sink colonization.[2,4,6]

Given the challenges involved in cleaning and disinfecting sinks, we hypothesized that providing a simple cover for the sink strainer might be an effective strategy to prevent dispersal of organisms from contaminated sink drains. This approach is similar to a recent intervention in which a reduction in *Klebsiella pneumoniae* carbapenemase (KPC)-producing organisms were attributed to installation of covers on wastewater hoppers.[7] Here, we examined the efficacy of a novel sink drain cover in reducing dispersal of fluorescent gel and colonizing pathogens from sink drains. To assess real-world feasibility of implementing the devices, we also placed the sink drain covers in all sinks in patient rooms of an intensive care unit for 2 weeks.

Methods

A plastic drain cover termed Drain Armor was developed and tested in collaboration with Boehringer Laboratories (Phoenixville, PA). The device is a small piece of dome-shaped plastic designed to cover the sink strainer to prevent dispersal of organisms from contaminated drains while allowing water to flow into the drain (Fig. 1). Three suction cups hold the device in place. The presence of the device should not alter routine cleaning of the sink and adjacent countertop. The device can remain in place during cleaning, and the top surface can be wiped or sprayed with disinfectant when the bowl is cleaned. The device is intended for single use (ie, placed upon admission and discarded upon patient discharge or weekly). Contaminated devices should be removed while wearing gloves. The anticipated cost is ~$5 per device or ~$260 per sink if changed weekly.

We used a fluorescent gel (Glow Potion, Brevis, Salt Lake City, UT) to assess the ability of the sink cover to prevent dispersal from sink drains. We inoculated 1 mL of fluorescent gel just below the strainer of sinks in hospital rooms. The sink drain cover was installed, and the water was run for 30 seconds with the device in place. A black light was used to identify sites of dispersal of the fluorescent gel to the bowl and adjacent countertop or other surfaces within 15.25 cm (6 inches) of the bowl. The drain cover was removed, and the water was run until there was no evidence of continued dispersal of fluorescent gel. The sink bowl and countertop were cleaned to remove any dispersed marker and another 1 mL gel was inoculated. The water was then run for 30 seconds and dispersal was assessed.

We also examined the efficacy of the drain cover in preventing dispersal of colonizing bacteria from sinks in hospital rooms. Prior to testing, the sink bowl and adjacent countertop or other surfaces ≤ 15.25 cm (≤6 inches) from the bowl were disinfected with an improved hydrogen peroxide disinfectant, and surfaces were sampled with BBL Culture Swabs (Becton Dickinson, Franklin Lakes, NJ) premoistened with sterile water to confirm absence of gram-negative bacilli. The countertop or other adjacent surfaces were cultured again after running the water for 30 seconds both with and without the sink drain cover in place. For a subset of assessments, the sink bowls were cultured. Each bowl and adjacent surfaces were disinfected after each set of

Author for correspondence: Curtis J. Donskey, MD, Geriatric Research, Education, and Clinical Center 1110W, Louis Stokes Cleveland VA Medical Center, 10701 East Boulevard, Cleveland, Ohio 44106. E-mail: Curtis.Donskey@va.gov

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Fig. 1. Sink drain cover placed in a sink.

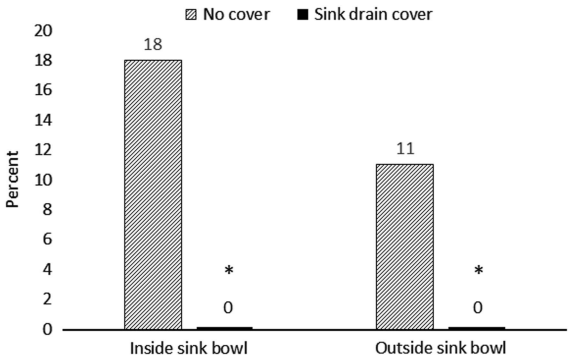

Fig. 2 . Percentage of sink bowls and surfaces outside the bowls with positive cultures for gram-negative bacilli after running the water for 30 seconds. Surfaces outside the bowls included countertops, sink edges, or other surfaces ≤15.25 cm (≤ 6 inches) outside the sink bowl. *, $P \leq .01$.

cultures. The water flow was adjusted to a rate typically used for hand hygiene.

After evaluation of dispersal of gram-negative bacilli, swabs inserted through an opening of the strainer were used to sample the proximal sink drain to a depth of 2.5 cm (1 inch) below the strainer. The swabs were plated onto MacConkey agar (Hardy Diagnostics, Santa Maria, CA) and incubated at 37°C for 24 hours. The Fisher exact test was used to compare the proportions of contamination with versus without the device in place.

To assess real-world feasibility of implementing the devices, we placed the sink drain covers in 20 sinks in patient rooms of a medical intensive care unit for 2 weeks. All drain covers were replaced after the initial 7 days, and individual devices were switched out if they became dislodged or if there was visible discoloration or biofilm. At the end of the study, we cultured the sink bowl and adjacent surfaces after running the water. In addition, the top surface of the devices was cultured for gram-negative bacilli. Nursing and environmental services personnel were interviewed regarding whether the devices caused disruption in normal care activities.

Results

The sink drain cover required ~15 seconds to install or remove. The device fit on all types of sinks tested and did not reduce water outflow. The drain cover was effective in preventing dispersal of fluorescent gel to countertops or other adjacent surfaces (0 of 30 [0%] vs 8 of 30 [27%] dispersal; $P = .005$). There was evidence of splashing of fluorescent gel from the drain to the bottom surface of the drain cover, but no dispersal was noted outside the cover.

Of 74 sinks cultured, 72 (97%) had gram-negative bacilli recovered from swabs inserted below the strainer. As shown in Fig. 2, the device prevented dispersal of colonizing gram-negative bacilli to the sink bowl and to surfaces adjacent to the bowl. All control cultures collected after disinfection but before running the water were negative.

During the 2-week period when the drain covers were installed in the medical intensive care unit, there were no reports of inconvenience to personnel or patients. Of the 20 drain covers, 1 (5%) was dislodged during cleaning requiring reattachment. On the final day of the drain cover placement, only 1 of the 20 (5%) devices had gram-negative bacilli recovered from the top surface, but the number of colonies was low (≤ 8 colony-forming units). No dispersal of gram-negative bacilli occurred when the water was run for 30 seconds.

DISCUSSION

In our facility, 97% of sink drains were colonized with gram-negative bacilli, and running water resulted in frequent dispersal to the sink bowl and surfaces outside the bowl. A novel sink drain cover was effective in preventing dispersal of gram-negative bacilli and a fluorescent gel. In a 2-week trial in an intensive care unit, most devices remained in place without substantial contamination of the exposed top surface, and there was no dispersal of gram-negative bacilli from sinks with the devices in place for 7 days.

Our findings suggest that the sink drain covers could provide a simple means to reduce dissemination of pathogens from contaminated sinks. Many alternative approaches that have been used to control outbreaks related to sinks may be costly or labor intensive. Such interventions include changing sink designs, placing barriers between sinks and work areas, replacing drainage systems, use of devices to disinfect P-traps, and complete elimination of sinks.[1–3,6–10]

Our study has some limitations. The study was conducted in 1 hospital. Although the device was effective for all sink designs in the facility, it is possible that modifications may be required to fit some designs used in other facilities. We only implemented the devices for a 2-week period in an intensive care unit, and we cannot exclude the possibility that limitations of the device were missed due to the short study period. Although we changed out the devices after 1 week during our trial, it is possible that less frequent changes may be required. Thus, further studies are needed including randomized trials to determine the effectiveness of the devices in preventing colonization and infection with sink-associated pathogens in healthcare facilities.

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References

1. Kanamori H, Weber DJ, Rutala WA. Healthcare outbreaks associated with a water reservoir and infection prevention strategies. *Clin Infect Dis* 2016;62:1423–1435.
2. Kizny Gordon AE, Mathers AJ, Cheong EYL, *et al*. The hospital water environment as a reservoir for carbapenem-resistant organisms causing hospital-acquired infections-a systematic review of the literature. *Clin Infect Dis* 2017 May 15;64:1435–1444.
3. Decker BK, Palmore TN. Hospital water and opportunities for infection prevention. *Curr Infect Dis Rep* 2014;16:432.
4. Hota S, Hirji Z, Stockton K, Lemieux C, Dedier H, Wolfaardt G, Gardam MA. Outbreak of multidrug-resistant *Pseudomonas aeruginosa* colonization and infection secondary to imperfect intensive care unit room design. *Infect Control Hosp Epidemiol* 2009;30:25–33.
5. Kotay S, Chai W, Guilford W, Barry K, Mathers AJ. Spread from the sink to the patient: in situ study using green fluorescent protein (GFP) expressing-*Escherichia coli* to model bacterial dispersion from hand washing sink trap reservoirs. *Appl Environ Microbiol* 2017;83(8):pii:e03327–16.
6. Gbaguidi-Haore H, Varin A, Cholley P, Thouverez M, Hocquet D, Bertrand X. A bundle of measures to control an outbreak of *Pseudomonas aeruginosa* associated with P-trap contamination. *Infect Control Hosp Epidemiol* 2018;39:164–169.
7. Mathers AJ, Vegesana K, German Mesner I, *et al*. Intensive care unit wastewater interventions to prevent transmission of multi-species *Klebsiella pneumoniae* carbapenemase (KPC)–producing organisms. *Clin Infect Dis* 2018. doi: 10.1093/cid/ciy052.
8. Hopman J, Tostmann A, Wertheim H, *et al*. Reduced rate of intensive care unit acquired gram-negative bacilli after removal of sinks and introduction of 'water-free' patient care. *Antimicrob Resist Infect Control* 2017;6:59.
9. Wolf I, Bergervoet PW, Sebens FW, van den Oever HL, Savelkoul PH, van der Zwet WC. The sink as a correctable source of extended-spectrum β-lactamase contamination for patients in the intensive care unit. *J Hosp Infect* 2014;87:126–130.
10. Deasy EC, Moloney EM, Boyle MA, *et al*. Minimizing microbial contamination risk simultaneously from multiple hospital washbasins by automated cleaning and disinfection of U-bends with electrochemically activated solutions. *J Hosp Infect* 2018. doi: 10.1016/j.jhin.2018.01.012

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