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Brief Report

Impact of routine use of a spray formulation of bleach on *Clostridium difficile* spore contamination in non-*C difficile* infection rooms

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The frequency of recovery of *Clostridium difficile* spores from surfaces after postdischarge cleaning of non-*C difficile* infection rooms was significantly reduced from 24%-5% after a commercial spray formulation of bleach was substituted for a quaternary ammonium disinfectant. These results suggest that routine use of a sporicidal disinfectant in all postdischarge rooms could potentially be beneficial in reducing the risk for *C difficile* transmission from contaminated surfaces.

Infection control measures to prevent *Clostridium difficile* transmission focus primarily on patients with *C difficile* infection (CDI). However, several recent studies suggest that asymptomatic carriers might play an underappreciated role in transmission of *C difficile*.[1-3] Moreover, screening for and isolating asymptomatic carriers has been associated with a reduction in the incidence of health care –associated CDI.[4] Unfortunately, screening for carriage of *C difficile* can be costly, labor-intensive, and inefficient for rapid detection of carriers.

One practical approach to address environmental shedding by asymptomatic carriers might be to use a sporicidal disinfectant for all postdischarge cleaning. However, there is relatively little information on the frequency of *C difficile* spore contamination in non-CDI rooms after cleaning with non-sporicidal disinfectants. In addition, there is concern regarding use of standard bleach products for all patient rooms because they are corrosive, irritating to some personnel and patients, and dry leaving a visible residue.[5] Here, we examined the frequency of *C difficile* contamination in non-CDI rooms after cleaning with a quaternary ammonium disinfectant and tested the hypothesis that routine use of a commercial spray formulation of bleach would reduce contamination.

METHODS

The Louis Stokes Cleveland Veterans Affairs Medical Center is a 215-bed acute care facility. Environmental services (EVS) personnel receive education on cleaning and on the importance of their work at monthly staff meetings. Cleaning is routinely monitored using both adenosine triphosphate measurements and fluorescent markers to assess thoroughness of cleaning. Ultraviolet light devices are used as an adjunct to standard cleaning and disinfection, but only in CDI rooms.

Prior to May 1, 2018, the facility used commercial bleach wipes for daily and postdischarge cleaning of CDI rooms and a quaternary ammonium disinfectant for non-CDI rooms. The quaternary ammonium product was applied using microfiber cloths. After May 1, 2018, EVS personnel used Clorox Healthcare Fuzion Cleaner Disinfectant (Clorox, Oakland, CA) for postdischarge cleaning and disinfection of CDI and non-CDI rooms. The spray product contains ingredients that are purported to decrease odor, residue on surfaces, and corrosive effects. EVS personnel were educated regarding how to use the spray bleach product based on the manufacturer's recommendations. For non-CDI rooms, EVS personnel were told to preclean areas with visible soiling by wiping with a microfiber cloth and then spray a sufficient quantity of the bleach spray to thoroughly wet surfaces such that they remained wet for a minimum of 2 minutes of contact time.

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For CDI rooms, EVS personnel were told that all high-touch surfaces should be cleaned prior to applying the spray bleach product. The EVS personnel were informed that the sprayed surfaces could either be wiped with a microfiber cloth after a 2-minute contact time or allowed to air dry without wiping. EVS personnel were informed that the change was made because the bleach product has activity against *C difficile* spores. However, EVS personnel were not provided with education on environmental cleaning and disinfection beyond the routine education provided at monthly staff meetings.

Because the spray bleach product has a reduced concentration of sodium hypochlorite in comparison to many other bleach products (0.39%), we initially tested its efficacy versus Clorox Healthcare Bleach Germicidal Cleaner (Clorox) (0.65% sodium hypochlorite) and Avert Sporicidal Disinfectant Cleaner (Diversey, Sturtevant, WI) containing 1.31% sodium hypochlorite for killing of *C difficile* spores. Three strains of *C difficile* were tested, including American Type Culture Collection (ATCC) strain 43598, VA17 (a restriction endonuclease analysis BI strain), and VA11 (a restriction endonuclease analysis type J strain). We tested disinfectant efficacy with a 2-minute exposure time in the presence of 5% fetal calf serum using AOAC International Germicidal Spray Products as Disinfectants (AOAC 961.02).[6] The 2-minute exposure time was chosen because this is the contact time recommended for spray bleach product for *C difficile* spores. Each of the products was sprayed once at 6 inches from the stainless-steel carriers. This method of application was chosen because Clorox Healthcare Fuzion Cleaner Disinfectant is applied as a spray. The carriers were neutralized with Dey-Engley neutralizer (Remel Products, Lenexa, KS). Serial dilutions were plated onto *C difficile* selective media and incubated inside an anaerobic chamber at 37°C for 72 hours.[3] Log reductions were calculated by subtracting viable organisms recovered after exposure to the disinfectants versus deionized water controls. Experiments were performed in triplicate.

We compared the frequency of environmental contamination with *C difficile* spores and methicillin-resistant *Staphylococcus aureus* (MRSA) in non-CDI rooms during 3-week periods before versus after the change from the quaternary ammonium disinfectant to the spray bleach product. We cultured a subset of all non-CDI rooms, including rooms cleaned on weekdays between 9 AM and 5 PM when our study coordinator was available, provided that the room could be sampled after cleaning but prior to admission of the next patient. One culture was obtained by sampling multiple high-touch surfaces in the patient room, and another was obtained by sampling surfaces in the bathroom. The bathroom cultures were not taken from the 2-patient rooms with shared bathrooms. For MRSA, 1 replicate organism detection and counting plate containing BBL CHROMagar (Becton Dickinson, Cockeysville, MD) with cefoxitin 6 μg/mL was used to contact 3 sites in the patient room (ie, bed rail, bedside table, and call button) and another was used to contact 2 sites in the bathroom (ie, hand grab bar and top surface of the toilet seat). The replicate organism detection and counting plates were imprinted onto 3 adjacent areas on each site. For *C difficile*, sterile gloves were donned and sterile 2 × 2-cm gauze pads premoistened with Dey-Engley neutralizer were used to sample the same sites in the patient room and bathroom. One gauze pad was used for the sites in the patient room and another gauze pad for the sites in the bathroom. The gauze pads were applied to the entire surface area of the call button, hand grab bar, and top surface of the toilet seat and to a 10 × 80-cm area of the bed rail and a 20 × 80-cm area on the top surface of the bedside table. Broth-enrichment cultures for *C difficile* and cultures for MRSA were processed as previously described.[1,7,8] Ten EVS personnel were surveyed regarding their opinion of the spray bleach product in regard to odor and residue on surfaces.

The primary outcome was the percentage of rooms with environmental contamination with *C difficile* spores (patient room, bathroom, or both sites) before versus after the change in disinfectants. The Fisher exact test was used to compare the percentages of contamination for each organism and site before versus after the change.

RESULTS

Each of the 3 commercial bleach products reduced *C difficile* spores by ≥6.0 $\log_{10}$ colony-forming units, with a 2-minute contact time. All 10 of the EVS personnel surveyed noted that the spray bleach product left less residue than other bleach products and believed that this was an advantage of the spray product. Four of the 10 (40%) EVS personnel believed that the spray product had a more tolerable odor than other bleach products, but none considered this to be an important consideration in choice of bleach products.

A total of 51 non-CDI rooms were cultured after postdischarge cleaning and disinfection during the period when a quaternary ammonium disinfectant was used, and 39 non-CDI rooms were cultured during the period when the spray bleach product was used. As shown in Figure 1, 24% of the rooms had contamination at 1 or both sites with *C difficile* and 10% had contamination of 1 or both sites with MRSA during the period when the quaternary ammonium disinfectant was used. The frequency of contamination with both organisms was similar on high-touch surfaces in patient rooms and in bathrooms. The percentage of rooms contaminated with *C difficile* was significantly reduced during the period when the spray bleach product was used (2 of 39, 5% vs 12 of 51, 24%; $P = .02$) and there was a trend toward reduced MRSA contamination (5 of 51, 10% vs 0 of 39, 0%; $P = .07$) (Fig 1).

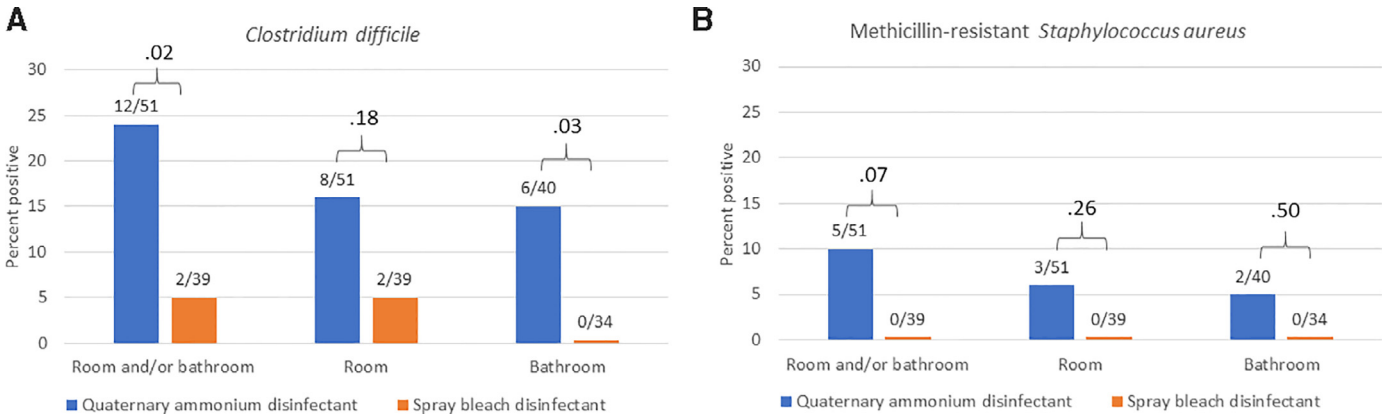

Fig 1. Percentage of non-*Clostridium difficile* infection rooms with positive cultures for *C difficile* (A) or methicillin-resistant *Staphylococcus aureus* (B) after postdischarge cleaning during a period when a quaternary ammonium disinfectant was used versus during a period when a spray bleach disinfectant was used. *CDI*, *C difficile* infection.

DISCUSSION

During a baseline period, when a non-sporicidal quaternary ammonium disinfectant was used, *C difficile* spores were recovered from 24% of non-CDI rooms after postdischarge cleaning. After a change to routine use of a spray bleach product for all postdischarge room disinfection, there was a significant reduction in recovery of *C difficile* after cleaning to 5% of non-CDI rooms. These results suggest that routine use of a sporicidal disinfectant in all postdischarge rooms could potentially be beneficial in reducing the risk for *C difficile* transmission from contaminated surfaces.

Our results are consistent with previous studies that have demonstrated that *C difficile* spores may be recovered from non-CDI rooms.[1] Such contamination might be owing to shedding of spores by asymptomatic carriers or CDI patients previously admitted to the same room. Use of non-sporicidal disinfectants may facilitate persistence of spore contamination because wiping with these products may result in transfer of spores from contaminated to clean sites in the room.[9] It is likely that use of the spray bleach product resulted in reduced spore contamination primarily owing to its activity against spores. Given that MRSA contamination was also reduced after the product substitution, it is also possible that the reduction in spore contamination was in part owing to improved coverage of surfaces with use of the spray product.

Our study has some limitations. The evaluation was conducted in 1 acute care facility and for a limited time before and after the product substitution. We did not include an evaluation of cleaning practices before versus after the product substitution. However, adenosine triphosphate readings taken to assess cleaning were similar during the periods before and after the product substitution (ie, >90% pass rate). In addition, fluorescent marker removal from high-touch surfaces during postdischarge cleaning in the baseline period was >90%. Fluorescent marker removal was not measured during the period when the spray bleach product was used because precleaning in non-CDI rooms was only performed on areas with visible soil, and wiping was not always performed after application of the spray bleach product (ie, the surfaces may have been allowed to air dry without wiping). We did not compare the efficacy of the spray bleach product with versus without thorough prior wiping of surfaces. However, it has previously been shown that real-world organic residue on surfaces do not substantially reduce the efficacy of bleach or ultraviolet light as long as visible soil is removed.[10] We only tested 1 sporicidal disinfectant product, but it is likely that other sporicidal disinfectants would also reduce spore contamination. We did not have information on *C difficile* colonization and did not collect detailed information on MRSA colonization pressure on the study wards. However, there were no CDI or MRSA outbreaks or formulation changes during the study period. The surface area sampled for MRSA was smaller than the surface area sampled for *C difficile*.

CONCLUSIONS

Our results suggest that use of sporicidal disinfectants for all postdischarge room disinfection might be helpful in reducing the risk for *C. difficile* transmission from contaminated surfaces. Future studies are needed to determine if routine use of sporicidal disinfectants in non-CDI rooms will result in a reduction in rates of CDI.

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