CONCISE COMMUNICATION

Daily Disinfection of High-Touch Surfaces in Isolation Rooms to Reduce Contamination of Healthcare Workers' Hands

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In a randomized nonblinded trial, we demonstrated that daily disinfection of high-touch surfaces in rooms of patients with *Clostridium difficile* infection and methicillin-resistant *Staphylococcus aureus* colonization reduced acquisition of the pathogens on hands after contacting high-touch surfaces and reduced contamination of hands of healthcare workers caring for the patients.

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Contaminated environmental surfaces are an important source for transmission of healthcare-associated pathogens such as *Clostridium difficile*, methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant enterococci (VRE).[1-4] In fact, recent studies suggest that healthcare workers' hands are as likely to become contaminated with these pathogens after contact with high-touch surfaces as after direct contact with patients.[2-4] Moreover, Samore et al[1] demonstrated a positive correlation between the percentage of positive environmental cultures for *C. difficile* and isolation of *C. difficile* from hands of hospital personnel. Daily disinfection of the skin of patients using chlorhexidine gluconate has been shown to be an effective method to reduce transmission of MRSA and VRE,[5,6] but it is not known whether daily disinfection of high-touch environmental surfaces is similarly beneficial as an adjunctive infection control measure. Therefore, we tested the hypothesis that daily disinfection of high-touch surfaces in rooms of patients with *C. difficile* infection (CDI) and MRSA carriage would reduce the frequency of contamination of healthcare workers' hands with these pathogens.

METHODS

The Cleveland Veterans Affairs Medical Center is a 215-bed hospital with an affiliated long-term care facility. During the study period, all patients were screened for MRSA nares colonization upon admission, ward transfer, and discharge; colonized patients were placed in contact precautions. CDI patients were maintained in contact precautions from the time of diagnosis until 48 hours after completion of CDI therapy. Sodium hypochlorite was used by housekeeping staff for disinfection of CDI rooms and MRSA isolation rooms after patient discharge. Bathrooms and floors in patient rooms were cleaned daily by housekeepers, but high-touch surfaces adjacent to patients were not cleaned on a daily basis unless they were visibly soiled. On the basis of removal of fluorescent marker from surfaces, less than 10% of high-touch surfaces in CDI or MRSA rooms were cleaned daily by housekeepers during the study period.

We conducted a prospective, randomized trial of standard cleaning (ie, high-touch surfaces cleaned only if soiled) versus daily disinfection of high-touch surfaces (ie, bed rails, bedside table, call button, telephone, chair, wall-mounted vital signs equipment, intravenous medication stand, door knobs and handles, bathroom hand rail, and toilet seat) in CDI and MRSA isolation rooms. Randomization was conducted by flipping a coin to allocate patients into 1 of the groups and was carried out separately for the CDI and MRSA patients. CDI patients were enrolled within 2 days of diagnosis. The staff members processing the cultures were blinded to the identity of the study groups.

In rooms randomized to daily disinfection, surfaces were disinfected by research staff each morning for 7 days or until discharge using a peracetic acid–based disinfectant (surface sporicide and disinfectant [SSD], STERIS). SSD was chosen for daily disinfection because preliminary studies indicated that it was as effective as sodium hypochlorite solution (5,000 parts per million) but less corrosive to a variety of materials and less irritating to patients and cleaning staff (S.K. and C.J.D., unpublished data). Cleaning of rooms after patient discharge was performed by housekeepers with no change from usual practices. Chart review was performed to obtain information on demographics, medical conditions, medications, and laboratory tests. We calculated a functional capacity score (1, independent; 2, requirement of assistance in daily activities; and 3, bedridden). The hospital's institutional review board approved the study protocol.

Six to 8 hours after the disinfection procedure, investigators donned sterile gloves, contacted high-touch surfaces, and then imprinted their gloves onto selective media agar plates for culture of the pathogens as described elsewhere.[3,4] Three separate cultures were obtained after contacting the bed rail and bedside table, the call button and phone, and the toilet seat and bathroom hand rail. In addition, samples taken from the hands of the primary physicians and nurses caring for the patients were cultured in the afternoons to assess the frequency of hand contamination; hand cultures were collected at least 2 days after enrollment in the study. Fisher exact test was used for categorical data. Student unpaired *t* test was used to compare mean colony counts of pathogens acquired on hands.

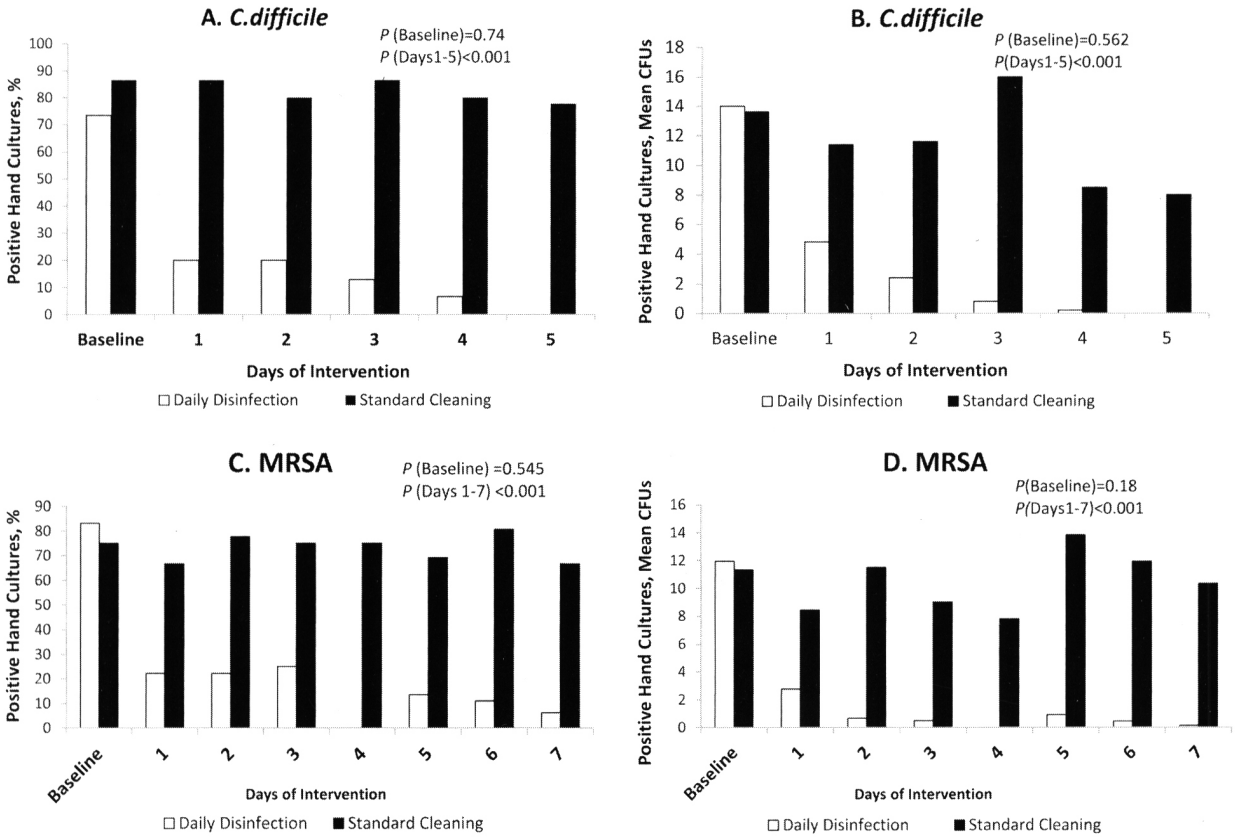

FIGURE 1. Effect of daily disinfection of high-touch environmental surfaces on acquisition of *Clostridium difficile* and methicillin-resistant *Staphylococcus aureus* (MRSA) on gloved hands of investigators after contact with the surfaces. *A*, Percentage of positive *C. difficile* cultures; *B*, mean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

RESULTS

Of 70 total patients, 34 had CDI and 36 had MRSA carriage. For the CDI group, there were no significant differences between the standard cleaning and daily cleaning groups with regard to age (mean, 65 vs 68 years old, respectively; $P = .53$), functional capacity score (2.1 vs 1.8, respectively; $P = .90$), severe CDI (38% vs 44%, respectively; $P = .74$), or duration of participation in the study (mean, 4.9 vs 5.2 days, respectively; $P = .59$). For the MRSA group, there were no significant differences between the standard and daily cleaning groups with regard to age (mean, 54 vs 53 years old, respectively; $P = .82$), functional capacity score (2.7 vs 2.6, respectively; $P = .58$), treatment with antibiotics active against MRSA during the study (35% vs 29%, respectively; $P = 1.0$), or duration of participation in the study (mean, 6.8 vs 6.2 days, respectively; $P = .48$).

As shown in Figure 1, baseline levels of environmental contamination were similar in standard cleaning and daily disinfection rooms ($P > .18$ for all comparisons). Daily disinfection of high-touch surfaces was associated with a significant reduction in the frequency of acquisition of both pathogens on investigators' hands after contact with the surfaces and in the mean number of colony-forming units acquired. As shown in Table 1, cultures of the hands of the healthcare workers caring for the patients were positive less often in the daily disinfection versus the standard cleaning groups, and the reduction was statistically significant for the MRSA group and for both groups combined.

Disinfection of high-touch surfaces required about 20 minutes per room. Patients in the rooms reported no adverse effects during use of the product, and there were no complaints from the nursing staff. There were no obvious adverse effects on the surfaces being disinfected with SSD.

DISCUSSION

Current guidelines for *C. difficile* recommend disinfection of surfaces in CDI rooms as a means to prevent transmission but focus primarily on disinfection of rooms after patient discharge.[7,8] Recently, Orenstein et al[9] reported that postdischarge and daily disinfection of inpatient rooms using bleach wipes was associated with a reduction in the incidence of hospital-acquired CDI on 2 hospital units. Similarly, Hayden et al[10] demonstrated that improved postdischarge and daily cleaning in a medical intensive care unit reduced VRE con-

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TABLE 1. Frequency of Healthcare Worker Hand Contamination

Culture	Daily disinfection	Standard cleaning	*P* value
Clostridium difficile	0/20 (0%)	3/28 (11%)	.255
MRSA	3/27 (11%)	15/38 (39%)	.013
Total	3/47 (6.4%)	18/66 (30%)	.001

tamination of the environment and hands of healthcare workers and reduced VRE cross-transmission. Our randomized trial expands on those results by highlighting the potential importance of daily disinfection of isolation rooms. Our findings suggest that daily disinfection of high-touch surfaces in isolation rooms may address an important source of healthcare worker hand contamination and provide a useful adjunctive measure to reduce transmission. The intervention was simple, inexpensive, and well accepted by patients.

Our study has several limitations. (1) Although the staff members processing cultures were blinded, other members of the research team were not. (2) We used a peracetic acid-based agent rather than a more widely used disinfectant such as hypochlorite. However, it is likely that similar results would be obtained with any sporicidal agent that is applied correctly. In fact, we have subsequently found that hypochlorite wipes (5,000 parts per million) used by research staff are very effective in reducing contamination of high-touch surfaces in CDI rooms (S.K. and B.M.S., unpublished data). (3) Daily disinfection was performed by research staff rather than by housekeepers. Additional studies are needed to evaluate the effectiveness of daily cleaning performed by housekeepers. (4) We examined acquisition of pathogens on hands 6–8 hours after disinfection and did not collect cultures after 24 hours. Therefore, further studies are needed to determine whether daily or more frequent disinfection is optimal to minimize the risk for transmission from surfaces. (5) We did not measure adherence to hand hygiene and contact precautions for the healthcare workers whose hands were cultured. We have previously found that healthcare workers' compliance with glove use is higher in CDI than MRSA isolation rooms in our facility (85% vs 45%, respectively; unpublished data), possibly explaining why healthcare workers had more frequent hand contamination with MRSA than with *C. difficile*. (6) We did not attempt to assess whether healthcare worker hand contamination was due to noncompliance with glove use or lack of proper technique when removing gloves. (7) Molecular typing was not performed to determine whether hand isolates matched environmental isolates. (8) Studies are needed to determine whether daily disinfection of surfaces will reduce rates of transmission.

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