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Major article

Use of a daily disinfectant cleaner instead of a daily cleaner reduced hospital-acquired infection rates

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Background: Documenting effective approaches to eliminate environmental reservoirs and reduce the spread of hospital-acquired infections (HAIs) has been difficult. This was a prospective study to determine if hospital-wide implementation of a disinfectant cleaner in a disposable wipe system to replace a cleaner alone could reduce HAIs over 1 year when housekeeping compliance was ≥80%.

Methods: In this interrupted time series study, a ready-to-use accelerated hydrogen peroxide disinfectant cleaner in a disposable wipe container system (DCW) was used once per day for all high-touch surfaces in patient care rooms (including isolation rooms) to replace a cleaner only. The HAI rates for methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), and *Clostridium difficile* were stratified by housekeeping cleaning compliance (assessed using ultraviolet-visible marker monitoring).

Results: When cleaning compliance was ≥80%, there was a significant reduction in cases/10,000 patient days for MRSA ($P = .0071$), VRE ($P < .0001$), and *C difficile* ($P = .0005$). For any cleaning compliance level there was still a significant reduction in the cases/10,000 patient days for VRE ($P = .0358$).

Conclusion: Our study data showed that daily use of the DCW applied to patient care high-touch environmental surfaces with a minimum of 80% cleaning compliance was superior to a cleaner alone because it resulted in significantly reduced rates of HAIs caused by *C difficile*, MRSA, and VRE.

Hospital-acquired infections (HAIs) caused by antibiotic-resistant organisms (AROs), such as vancomycin-resistant enterococci (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA), and *Clostridium difficile*, represent a significant impact on patient morbidity and mortality and financial burden on the health care system.[1-3] It is well known that transmission of AROs can occur via contaminated hands of caregivers either after contact with a patient who carries an ARO or after contact with this patient's environment.[3-7] As such, much effort has been spent improving the hand hygiene compliance of health care providers. There is ample evidence that hospitalized patients who carry or are infected with AROs shed these organisms into their environment, which then becomes a reservoir for subsequent transmission.[2,4–13] Furthermore, the increased risk of a new patient acquiring an ARO when admitted to a room previously occupied by another patient with this ARO has also been reported.[14-17] There are a number of studies documenting that disinfection of the high-touch areas reduces the load of AROs in the health care environment.[4,6,7,10–13,18] Others have reported that room decontamination using various new technologies (eg, ultraviolet [UV] light, vapors of hydrogen peroxide, peracetic acid) could also eliminate or reduce the presence of viable bacteria and spores in patient rooms.[13,19,20] The Kundrapu et al[4] study demonstrated that reduced microbial load in the patient environment using daily disinfection instead of a nondisinfectant cleaning agent led to reduced presence of AROs on the hands of caregivers.

The Ontario Provincial Infectious Disease Advisory Committee[2] and the U.S. Center for Disease Control and Prevention[3,21] now recommend the use of disinfection, in addition to cleaning, in high-touch patient care environments. However, as reviewed by

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Donskey[6] and Otter et al,[5] the impact of effective decontamination of the environmental reservoir on the rate of HAIs caused by AROs is still unclear.

To effectively assess the role of environmental disinfection in HAI transmission, it is critical to confirm that the surface was actually wiped with the disinfectant.[4,7,8,12] The Ontario Provincial Infectious Disease Advisory Committee[2] recommends the use of either Ultraviolet-visible marker (UVM) or adenosing triphosphate as methods for monitoring cleaning compliance (CC) of high-touch patient care environments.

The objective of the current study was to prospectively evaluate whether daily hospital-wide use of disinfectant cleaner in place of the existing nondisinfectant cleaner could lead to a significant reduction of HAI rates for MRSA, VRE, and *C difficile*.

MATERIALS AND METHODS

Setting

This study was undertaken in a 538-bed acute care tertiary hospital in Canada. The study started in November 2012 and continued for 52 weeks. The medicine, cardiac, surgery, and women and child wards with admitted patients were included. A second acute care tertiary hospital in the same city was used as a comparator hospital that used a nondisinfectant cleaner throughout all patient care areas and only used a disinfectant cleaner for *C difficile* isolation rooms. The intervention hospital has an older patient population with longer hospital stays compared with the nonintervention hospital.

Design

This was an interrupted time series study design with a control group. This was a prospective study. At the intervention site, HAI rates (cases/10,000 patient days) for VRE, MRSA, and *C difficile* on all wards with admitted patients were tabulated each week. The definition of hospital-acquired VRE, MRSA, and *C difficile* prior to and during the intervention period followed the Manitoba health guidelines.[22] The UV-visible marker system previously described by Alfa et al[12] has been in use at the intervention site for the last 7 years. This monitoring process continued during the intervention period to confirm if surfaces had been wiped with disinfectant cleaner. However, the frequency of monitoring was increased to ensure the HAI rates each week could be stratified based on CC. Two patient care rooms on each of the 15 study wards were assessed each week (ie, 30 rooms/week), whereas historically, approximately 15 patient care rooms were monitored throughout the hospital per week. Monitoring was done by marking approximately 15 of 35 potential high-touch sites in the bedroom and bathroom. The rooms on each ward were selected randomly each week, and the 15 high-touch sites selected varied from week to week. As per the hospital's existing monitoring benchmark, cleaning was considered acceptable provided that a minimum of 80% of the UV-visible marks were partially or completely removed. At the control hospital site (nonintervention site), the hospital-wide HAI data were also tabulated prospectively, but this site did not use a cleaning monitoring protocol.

Participants

As per hospital policy, on admission, known MRSA- or VRE-positive patients were placed on contact precautions and where possible were admitted to a single room. Patients of unknown status were screened on admission for MRSA and VRE based on risk factors established by the Manitoba health guidelines.[23] Only hospital-acquired carriage or infection of VRE or MRSA were included in the HAI rate determinations. Both the Manitoba health guidelines and Canadian National Infection Surveillance Program (CNISP) data combine carriage and infection related to VRE and MRSA in their HAI definitions and rates. MRSA screening of hospitalized patients was done by direct culture on MRSASelect chromogenic media (Bio-Rad Laboratories, Mississauga, ON, Canada), with results provided 24 hours after inoculation. VRE screening of hospitalized patients was done using VRE Selective Broth (Oxoid, Nepean, ON, Canada), with positive broths (blackening of broth and loss of fluorescence) subcultured to VRESelect chromogenic media (Bio-Rad Laboratories, Mississauga, ON, Canada). Results were generally available 48-72 hours after inoculation. *C difficile* infection was diagnosed using a previously described multistep algorithm.[24]

Intervention

The historically used cloths (cotton rags) and PERdiem (Diversey Inc, Mt Pleasant, WI) cleaning agent, which was used at a 1:64 use dilution (not a disinfectant at this use dilution), were replaced with Accel INTERVention (Virox Technologies, Oakville, ON, Canada), which is a ready to use 0.5% (weight/volume) accelerated hydrogen peroxide disinfectant and cleaner that was used in a disposable wipe (Diversey Inc, Mt Pleasant, WI) and bucket system (Virox Technologies, Oakville, ON, Canada). This product is referred to as the disinfectant cleaner wipe (DCW) and is a 1-step surface disinfectant with a 1-minute contact time against vegetative bacteria, enveloped and nonenveloped viruses, and mycobacteria. The control hospital site continued to use the PERdiem cleaner (1:64 use dilution) with cotton rags. This product is referred to as the cleaner with cotton rags (CCR) and there are no disinfectant label claims at this use dilution. The DCWs were used daily throughout the intervention hospital in all high-touch patient care areas and for all patient-shared items. The CCR continued to be used daily for all floors and for nonpatient care areas at both the intervention and nonintervention hospitals. The housekeeping staff at the intervention site were trained in the use of the containerized disposable wipe system prior to the commencement of the study. For each patient zone, 2 wipes were used for the bed, bedside table, chair, and leading edge of the privacy curtain. The common zone used 1 wipe for the room door knob, computer keyboard and mouse, and other items in the common area; 3 wipes were used in the bathroom (includes the door knob). If a commode was present, a dedicated wipe was used whether in the patient or bathroom zone. This disposable wipe cleaning protocol was applied to isolation and nonisolation rooms and discharge rooms. All discharges also included more wipes for the mattress, bedframe, and inside of drawers and the removal of any patient supplies and the replacement of privacy curtains in isolation discharge rooms. The number of wipes used for patient-shared items depended on the size of the item.

Housekeeping personnel at the intervention hospital received same day feedback on CC based on UV-visible marker monitoring and were asked to reclean sites that were not adequately cleaned (this feedback process had been in place for >7 years prior to the start of the DCW study). The control hospital continued to use a CCR system and did not use a cleaning monitoring program.

The University of Manitoba Research and Ethics Committees approved this study. Patient consent was not sought out because patient care was not affected, and the DCWs were already approved and cleared for sale by Health Canada.