

Contamination of Hospital Curtains With Healthcare-Associated Pathogens

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In a culture survey, we found that 42% of hospital privacy curtains were contaminated with vancomycin-resistant enterococci, 22% with methicillin-resistant *Staphylococcus aureus*, and 4% with *Clostridium difficile*. Hand imprint cultures demonstrated that these pathogens were easily acquired on hands. Hospital curtains are a potential source for dissemination of healthcare-associated pathogens. *Infect Control Hosp Epidemiol* 2008; 29:1074-1076

Recent studies suggest that contaminated environmental surfaces may play an important role in transmission of healthcare-associated pathogens.¹⁻⁶ For example, we found that vancomycin-resistant enterococci (VRE) and *Staphylococcus aureus* were frequently acquired on hands after contact with contaminated surfaces in patients' rooms.² Boyce et al.³ similarly demonstrated that nurses frequently acquired methicillin-resistant *S. aureus* (MRSA) on gloves after touching surfaces near colonized patients. In a medical intensive care unit, Hayden et al.⁴ found that enforcing routine environmental cleaning measures was associated with decreased VRE contamination on surfaces and on the hands of healthcare workers (HCWs) and also with a significant reduction in VRE cross-transmission. Environmental decontamination with a 10% bleach solution has also been associated with reductions in the incidence of *Clostridium difficile*-associated disease.^{7,8} Hospital curtains that surround patients' beds to give privacy could provide a source for transmission of healthcare associated pathogens for several reasons. First, they are commonly touched by patients and HCWs. Second, in many institutions, they are cleaned or changed infrequently. Finally, HCWs may be less likely to disinfect their hands after contact with inanimate objects than after direct contact with patients.² Although recent studies have demonstrated contamination of hospital curtains with carbapenem-resistant *Acinetobacter baumannii* and MRSA,^{9,10} the potential for such contamination to contribute to transmission of pathogens is unknown.

We performed a culture survey to examine the frequency of contamination of hospital privacy curtains with healthcare-associated pathogens, and we tested the hypothesis that pathogens on curtains can easily be acquired on hands.

Methods

The Cleveland Veterans Affairs Medical Center is a 202-bed acute care hospital. At the time of the study, active surveillance for MRSA carriage was performed, and colonized or infected patients were placed under contact precautions. Patients

with *C. difficile*-associated disease were placed under contact precautions until they completed treatment and the diarrhea resolved. No active surveillance was performed for VRE, and patients colonized or infected with VRE were not placed under contact precautions.

In January 2008, samples for culture of VRE, MRSA, and *C. difficile* were collected from 50 privacy curtains on 7 wards, including 4 medical wards, a spinal cord injury ward, and medical and surgical intensive care units. The privacy curtains used in the hospital were manufactured by American Drapemasters and Caldwell's. The curtains were cleaned once every 4 months or if they were noted to be visibly soiled. It was noted if the samples were collected from an isolation room.

A 25-cm² area on the lateral edge of the middle section of the curtain was sampled for culture, because this is the area that HCWs most often contact with their hands when opening or closing the curtains. First, hand imprint cultures for VRE, MRSA, and *C. difficile* were performed: sterile gloves were donned and the curtain was gripped to simulate the motion of opening and closing the curtain; the gloved fingertips and thumb of the hand were then imprinted onto selective agar plates. For VRE, MRSA, and *C. difficile*, selective media included Enterococcosel agar (Becton Dickinson) containing 20 mg of vancomycin per milliliter; CHROMagar (Becton Dickinson) containing 6 mg of ceftiofur per milliliter; and cycloserine-ceftiofur-fructose agar, containing 0.1% taurocholic acid and lysozyme at a concentration of 5 mg/mL (CCFA-TAL). Second, direct plating cultures for VRE and MRSA were performed by applying premoistened, sterile cotton-tipped swabs to a 25-cm² area, followed by direct plating of the swab specimens onto selective agar. Direct plating cultures were performed to provide an approximation of the concentration of organisms on the curtains. Finally, broth enrichment cultures for VRE and *C. difficile* were performed: sterile gloves were donned and used to wipe the same area with a premoistened, sterile 2 x 2 cm gauze pad, which was then placed in a sterile specimen cup. Broth enrichment cultures were not performed for MRSA, because preliminary studies indicated that the yield was similar for broth enrichment and direct plating cultures.

Plates were incubated at 37°C for 48 hours. For VRE and MRSA, colonies with unique morphology were subjected to identification and susceptibility testing in accordance with Clinical Laboratories Standards Institute guidelines.¹¹ Broth enrichment cultures for *C. difficile* were performed as described elsewhere.¹² Toxin production was confirmed using the *C. difficile* Tox A/B II test (Wampole Laboratories), and contamination of hospital curtains 1075 figure. Rates of recovery of healthcare-associated pathogens from 50 hospital privacy curtains by 3 culture methods. For methicillin-resistant *Staphylococcus aureus* (MRSA), broth enrichment cultures were not performed. For *Clostridium difficile*, direct plating

cultures were not performed. VRE, vancomycin-resistant enterococci. isolates that did not produce toxin were excluded from the analysis.

Results

The Figure shows the percentage of tested curtains that yielded positive culture results for each pathogen. By direct plating culture, 10 (20%) of 50 curtains were positive for VRE, and 11 (22%) of 50 were positive for MRSA. For VRE, the median number of colonies obtained by direct plating culture was 2 (range, 1–4). For MRSA, the median number of colonies obtained by direct plating was 3 (range, 1–11). Broth enrichment cultures yielded a higher proportion of positive result for VRE (21 [42%] of 50 curtains) than for *C. difficile* (2 [4%] of 50 curtains).

Hand imprint cultures were positive for MRSA for 5 (45%) of the 11 curtains that were contaminated with MRSA; only 1 or 2 colonies of MRSA were recovered from hand imprint cultures for each of these 5 curtains. Hand imprint cultures were positive for VRE for 2 (20%) of the 10 curtains that were contaminated with VRE; only 1 colony of VRE was recovered after contact with each curtain. Hand imprint cultures were positive for *C. difficile* for 2 (100%) of the 2 curtains that had broth enrichment cultures positive for *C. difficile*.

Of the 50 curtains sampled for culture, 14 (28%) were in MRSA isolation rooms. There was a trend toward a higher rate of detection of MRSA on curtains in isolation rooms, compared with curtains in nonisolation rooms (6 [43%] of 14 curtains vs 5 [14%] of 36; $P = .052$); the same trend was seen for the rate of detection of VRE (8 [57%] of 14 curtains vs 13 [36%] of 36; $P = .176$). For VRE and MRSA, the proportion of curtains with positive culture results was highest on the medical wards (13 [59%] of 22 and 6 [30%] of 20 curtains, respectively) and lowest in the intensive care units (0 [0%] of 10 and 1 [7%] of 14 curtains, respectively).

Discussion

We found that 42% of hospital privacy curtains were contaminated with vancomycin-resistant enterococci, 22% with methicillin-resistant *Staphylococcus aureus*, and 4% with *Clostridium difficile*. Hand imprint cultures demonstrated that small numbers of these pathogens could be acquired on hands. Although we did not obtain evidence about environment-to-patient transmission, our data suggest that hospital curtains have the potential to contribute to contamination of HCWs' hands, the major source of transmission of nosocomial pathogens.

The most important implication of our study is that HCWs should perform hand hygiene after contact with hospital curtains. This is in agreement with the recommendation of the most recent guideline on hand hygiene in healthcare settings,

that HCWs routinely disinfect their hands after contact with inanimate objects in the vicinity of patients.¹ Other strategies to reduce the potential for transmission of pathogens from curtains might include improved or more frequent cleaning or use of antimicrobial-impregnated curtains. Because opening or closing curtains typically involves contact with only a small surface area on the edge of the curtain in the midsection, it might be feasible to provide plastic hand grips for opening and closing that are more easily cleaned than the curtain fabric.

Our study has some limitations. First, because only small numbers of the pathogens were detected, it is possible that the importance of curtains in transmission is low in comparison with the importance of other contaminated environmental surfaces that might be more heavily contaminated. However, we demonstrated that after hands touch bed rails and bedside tables in patients' rooms, the amount of MRSA or VRE acquired on the hands was also typically low (median colony count on culture, 3; range, 1–300).² In addition, Duckro et al.¹³ demonstrated frequent transfer of VRE from contaminated skin or environmental surfaces to clean sites via HCWs' hands; and they found that transfer was common even when low concentrations of VRE were present on the contaminated surfaces. In fact, 69% of the contaminated sites associated with transfer of VRE demonstrated growth of VRE only by broth enrichment culture. Second, we did not assess persistence of the pathogens on the curtains. However, previous studies suggest that VRE, MRSA, and *C. difficile* spores have the potential to persist for long periods on surfaces.¹⁴ Finally, we did not have information regarding the length of time since the curtains had been cleaned. Additional studies are needed to determine the timing of contamination of curtains and of other environmental surfaces in healthcare facilities.

In summary, we found that hospital privacy curtains were frequently contaminated with pathogens, and these organisms could be acquired on hands. Further research is needed to evaluate strategies to minimize the risk for patient-to-patient transmission of pathogens from contaminated curtains.

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