Bacterial Colonization of Respiratory Therapists' Pens in the Intensive Care Unit

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BACKGROUND: Prevention of nosocomial infections is of paramount importance. Person-to-person transmission of microorganisms is well recognized, but the role of fomites in nosocomial infection is not as well understood. Incomplete cleaning of equipment and patient rooms, and medical devices used with multiple patients are well-described means of transmission, but little attention has been paid to nonmedical devices as fomites. We collected bacteria from writing implements (pens) used by respiratory therapists in an intensive care unit, following their work shifts. METHODS: We obtained pens from 20 respiratory therapists, and cultured, enumerated, and identified the bacteria. RESULTS: Bacteria were found on 17 of the 20 pens. The mean ± SD number of colony-forming units was 126 ± 277 (range 0–1,250). Coagulase-negative staphylococci were found on all 17 pens. *Micrococcus* species were found on 4 pens. CONCLUSIONS: Although we found no organisms that are regularly associated with nosocomial infections (eg, methicillin-resistant *Staphylococcus aureus* or Gram-negative bacilli), pens can be fomites responsible for nosocomial infections. Protocols to reduce the transmission of infectious agents may need to be extended to writing instruments. One possible measure is to assign specific writing instruments to specific rooms. *Key words: nosocomial infection, bacteria, fomite, transmission, writing implement, respiratory therapist, pen.* [Respir Care 2009;54(4):500–503. © 2009 Daedalus Enterprises]

Introduction

Nosocomial infections have substantial impact on the United States health-care system. Hospital-acquired infections, particularly those caused by multiple-drug-resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) and extended-spectrum beta-lactamase-producing Gram-negative bacteria, prolong hospital stay and increase costs.[1] Although procedures and protocols have been developed to reduce the transmission of microorganisms responsible for nosocomial infections, eliminating the sources and transmission of those organisms remains a challenge.[2]

Potential microorganism reservoirs and vehicles of transmission include contaminated equipment and person-to-person spread, including transmission by clinicians from patient to patient. Many individuals harboring pathogens are not ill but only colonized. For example, individuals colonized with *S. aureus* or MRSA on the skin or nares are often asymptomatic but are a source of those organisms in the health-care setting; 30% to 60% of healthy adults are colonized with *S. aureus*,[3] and approximately 6% of clinicians had nasal MRSA in some studies.[4-6] Awareness of that carriage is important because the microorganisms can be transferred or spread from patient to patient, from clinician to patient, and from patient to clinician, and thus create a new reservoir for the organisms.

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Microorganisms can also be transferred via fomites (eg, bed rails, suctioning equipment, and bed linens). Noskin et al[7] reported that *Enterococcus faecalis* survived for 5 days, and *Enterococcus faecium* for 7 days, on countertops. Both species survived on bed rails for 24 hours, without a significant change in viable numbers. Transmission to the patient may occur via patient contact with the contaminated object, or via the hand of a clinician who has touched a contaminated object. Although policies and procedures exist to decontaminate equipment and patient rooms, incomplete cleaning of equipment and patient rooms between patients allows transmission from one patient to another.[8] Any contaminated surface in the room can be a reservoir and source of pathogens.[9]

Additional fomites include medical and nonmedical devices and items. Although these items may be decontaminated prior to use, they can still become transmitters because of improper or incomplete cleaning between patients.[10] For example, stethoscopes are frequently contaminated.[8,11] Smith et al found bacteria on 80% of 200 stethoscopes, and MRSA on 34%.[8]

Health-care facilities have taken steps to prevent nosocomial infections, including contact precautions and disinfection procedures, but clinicians need to maintain continual adherence to the anti-infection protocols, including handwashing and wearing gloves. Although clinicians understand that following these protocols is crucial in reducing person-to-person spread of pathogens, adherence to hand-hygiene recommendations is unacceptably low, usually well below 50%.[12-15] Bischoff et al found handwashing adherence as low as 3%, and that changed very little after an education/feedback intervention program.[16] Although adherence to hand-hygiene procedures differs among hospital wards and among the categories of clinicians, and in different working conditions, physicians have among the lowest adherence.[12,14-15]

In the intensive care unit (ICU), respiratory therapists (RTs) are required to wash their hands and put on new gloves before each patient they visit, but few RTs disinfect their writing implements between patients. Although, unlike a stethoscope, a pen usually does not directly contact the patient, and the clinician may not touch the pen until the patient interaction is completed, a pen can be a fomite. We tested RTs pens after their shifts in a medical/surgical ICU.

Methods

This study was approved by the institutional review board of the Upstate Medical University of the State University of New York, and performed at St Joseph's Hospital Health Center, Syracuse, New York.

We approached RTs in the medical/surgical ICU at St Joseph's Hospital Health Center at the ends of their shifts and asked to test the pens they were carrying for bacteria. All the RTs we approached consented to participate. Pens were obtained from 11 day-shift and 9 night-shift RTs over a 1-week period. With a saline-moistened swab we thoroughly wiped the entire surface of the pen, then placed the swab in 1 mL of sterile saline. We then vortexed the swab and saline for 10 s, to remove bacteria from the swab. We evenly distributed 100 μL of the saline on a 10% sheep blood agar plate, and incubated it at 35°C in room air. After 24 h and 48 h of incubation, we examined the plates. If bacteria were present, we determined the number of colony-forming units (CFUs) and identified the organisms with standard microbiological techniques, including colonial morphology, Gram-stain reaction, microscopic morphology, and biochemical test reactions.

We used a 2-sample *t* test with unequal variances to compare the difference in CFU counts between the day shifts and night shifts. Differences were considered significant when $P < .05$.

Table 1. Bacteria on Respiratory Therapists' Pens

Specimen Number	Shift	Colony-Forming Units	
		Coagulase-Negative *Staphylococcus*	*Micrococcus* species
1	Night	140	80
2	Night	200	0
3	Night	250	0
4	Night	20	0
5	Day	10	0
6	Day	0	0
7	Day	110	0
8	Day	10	0
9	Day	30	0
10	Day	20	0
11	Night	20	0
12	Night	50	10
13	Day	10	10
14	Day	30	0
15	Day	1	0
16	Day	220	0
17	Day	3	10
18	Night	0	0
19	Night	0	0
20	Night	1,250	0

Results

Of the 20 pens tested, 17 (85%) had bacterial contamination. There were a mean ± SD 126 ± 277 CFU/pen (range 0–1,250 CFU/pen). Coagulase-negative staphylococci were present on all 17 colonized pens. *Micrococcus* species were present on 4 pens (Table 1).

There was no significant difference between the day-shift and night-shift CFU counts ($P = .21$).

Discussion

Seventeen of the 20 pens had bacteria, but the organisms were normal skin flora. Studies of devices that touch the patient have found multiple-drug-resistant bacteria, such as MRSA.[8,11] The virulence of various stains of a given bacteria species differs greatly. Some pathogens can begin an infection with a small number of cells. For example, enterohemorrhagic strains of *Escherichia coli* require only about 10 bacterial cells.[17] Thus, although we did not find any organisms generally associated with nosocomial infection, we believe that a writing implement could transmit the small number of cells of a virulent strain that would cause nosocomial infection.

The large CFU range (0–1,250) we found might be attributable to several factors. The RTs were not aware they were going to be asked for their pens, and we observed that one RT was using an antimicrobial hand sanitizer just before he gave the pen to the researcher. The sanitizer on the RT's hands might have killed bacteria on the pen. Another pen we collected had just been wiped clean with an antimicrobial wipe, which was that RT's standard practice. Although we did not track which pen/bacteria came from which RT, we think that hand sanitizer and antimicrobial wipes might partly explain the wide range of CFUS on the 20 tested pens.

When we asked the RTs for their pens, most of them were at a desk, using the pen for end-of-shift paperwork, not in a patient room. In the patient room, while wearing gloves, the RT touches the patient, bed, linens, equipment, and the pen, to record data in the chart. Thus, the pen is presumably colonized, and the clinician could be colonized later by touching the pen without gloves, and thus could become a vector and contaminate other objects with his or her hand.

The difference between the day-shift and night-shift CFU counts was not significant, though the shifts had very disparate means (day 46 ± 65 CFU/pen, night 224 ± 398 CFU/pen). The main reason for the disparity between means was that one night-shift employee had a very high CFU count (1,250). The large standard deviations of the CFU counts make it difficult to demonstrate significance. There are several possible reasons the night-shift CFU counts tended to be higher than the day-shift counts. For example, ventilator checks might be less frequent near the end of shift, which could correspond to more time handling the pen outside of patient rooms, or a more relaxed atmosphere on the night-shift might correspond to worse adherence to infection-control protocols.

The organisms we recovered are normal indigenous and harmless skin flora. The most commonly identified microbes were coagulase-negative *Staphylococcus* species, which is routinely found in skin samples. However, most normal skin flora, though harmless on skin and mucous membranes of healthy individuals, may be pathogens in immunocompromised patients and patients with indwelling medical devices. An improperly cleaned injection site is a possible infection route. *Staphylococcus epidermidis* is a major cause of nosocomial infections in hospitalized patients with indwelling medical devices, and immunocompromised patients. Coagulase-negative staphylococci cause bloodstream infections in approximately 37% of ICU patients. Of those infections, 60–80% are methicillin-resistant.[18] In addition, *Micrococcus* species, which we found on 4 pens, is rarely reported as a pathogen but has been associated with indwelling-catheter infection.[19]

This study was only designed to detect organisms that can be easily cultured in the laboratory, but some organisms and viruses (eg, *Clostridium difficile*, rotavirus, and respiratory syncytial virus) that are not easily cultured are important nosocomial pathogens that can be transmitted via fomites and vectors. Also, our swab method of collecting microbes from the pens may not have collected all culturable bacteria. However, given the differences in pen shapes and sizes, we thought our sampling technique was the most effective standardizable method to sample the entire pen surface area.

We sampled only 20 pens because of the number of RTs assigned to the ICU at the time of the study. Many facilities have adopted handheld and tablet-style computers for recording clinical data, and a study of microbe contamination of those devices is needed. Also, studies with larger sample sizes, and sampling of other nonmedical devices, would help identify sources of nosocomial infection.

Conclusions

Pens can carry bacteria and are fomites. In contrast to the study by Smith et al,[8] who found MRSA and vancomycin-resistant enterococci on stethoscopes, we found only commensalistic microbes. This could be due to the fact that pens, unlike stethoscopes, usually do not touch the patient and may not be used until after the clinician-patient interaction. But pens are used both in and outside of the patient room and should therefore be treated as potential fomites and covered in the standard disinfection and contact-precaution protocols. One possible infection-control procedure is to have a writing implement assigned to each patient room.

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