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Brief Report

Spores on wheels: Wheelchairs are a potential vector for dissemination of pathogens in healthcare facilities

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In a hospital and affiliated long-term care facility, we found that shared wheelchairs were frequently contaminated with healthcare-associated pathogens, including *Clostridium difficile* spores. A network graph of 851 wheelchair transports over 3 days demonstrated frequent movement between inpatient wards and outpatient clinics, radiology, and physical therapy. These results highlight the potential for shared wheelchairs to serve as a vector for pathogen transmission.

Portable equipment that is shared among patients can be a potential source of pathogen transmission.[1-5] Thus, current guidelines recommend that medical equipment that comes into contact with intact skin be cleaned and decontaminated after each patient use.[4] Nurses and ancillary staff are often given responsibility for cleaning portable equipment because they use such equipment while working with patients. However, Havill et al[4] reported that portable equipment was often not cleaned according to written protocols between each patient use.

In a recent observational study, we reported that wheelchairs were among the most common items shared among patients.[5] However, few studies have evaluated the potential for wheelchairs to transmit pathogens. Maley[6] reported possible transmission of staphylococci by a wheelchair. Peretz et al[7] demonstrated that shared-use wheelchairs in a hospital were often contaminated with vegetative bacteria. In a survey of 48 Canadian healthcare facilities, Gardner et al[8] reported multiple concerns regarding cleaning and disinfection of wheelchairs. Here, we conducted a point-prevalence culture survey to examine the frequency of contamination of shared-use wheelchairs with pathogens and assessed the potential for shared wheelchairs to disseminate pathogens by evaluating shared wheelchair movement within the facility during a 3-day period to develop a network graph of wheelchair movement within a healthcare facility.

METHODS

The Louis Stokes Cleveland Veterans Affairs Medical Center is a 215-bed acute care facility with an adjacent 250-bed long-term care facility (LTCF). Shared-use wheelchairs are present throughout the facility, and hospital transport staff are available to assist patients. The facility policy states that wheelchairs should be wiped daily with a disinfectant wipe and as needed throughout the day if they become soiled. No routine monitoring of cleaning of wheelchairs is performed. Canisters of quaternary ammonium/alcohol disinfectant wipes are available at each location where wheelchairs are commonly stored in large numbers (eg, parking lot, emergency department) and on all hospital and LTCF wards.

To assess the frequency of contamination of wheelchairs with healthcare-associated pathogens, BBL CultureSwabs (Becton Dickinson, Cockeysville, MD) premoistened with Dey-Engley neutralizing medium (Remel, Lenexa, KS) were used to collect cultures from a 10-cm section of the wheels and the body (a single swab was used to sample a 5 × 10-cm area of the seat and the entire area of the arm rests) of a convenience sample of 40 wheelchairs from multiple different areas of the hospital and LTCF. Separate swabs were used for the wheels and the body. The cultures were processed for

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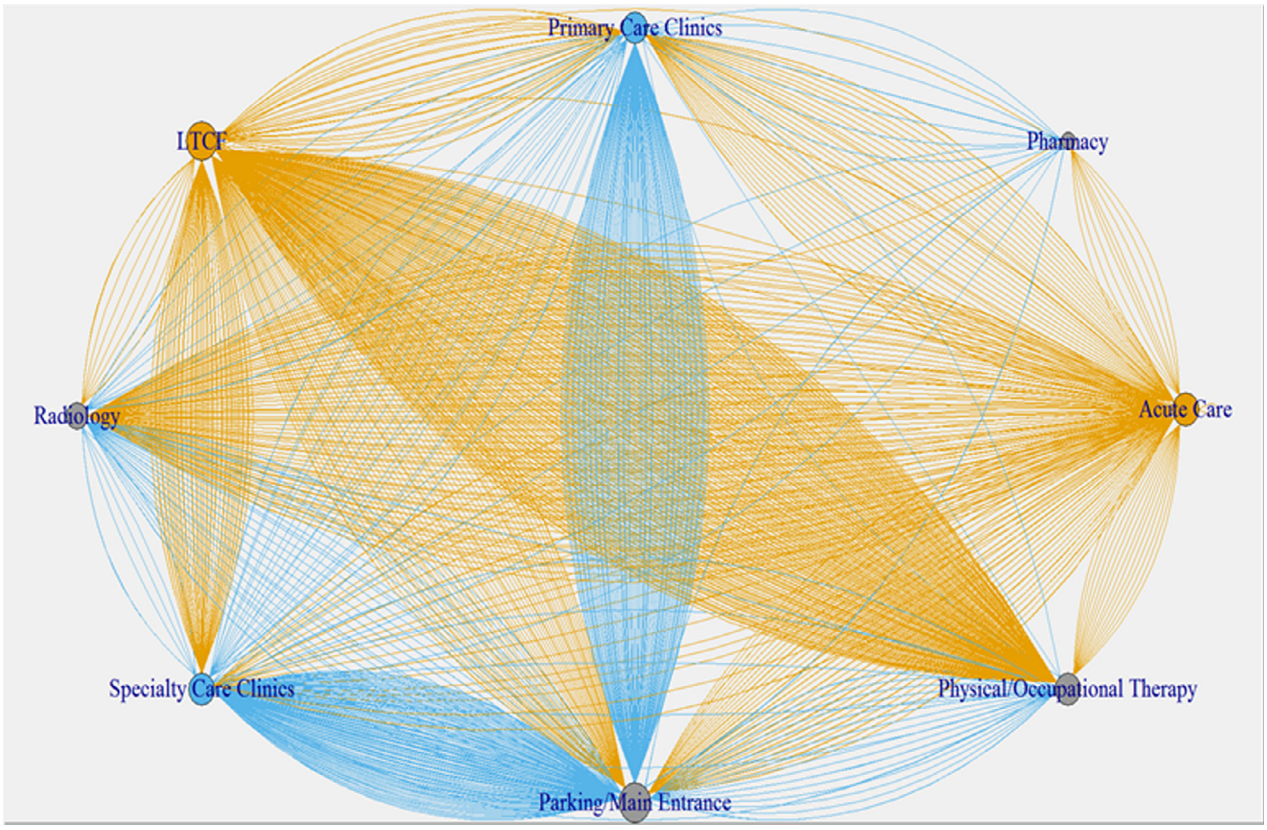

Fig 1. Network graph of wheelchair movement within the facility during 3-day period. Transports including inpatient origins or destinations are shown in yellow, and all other trips are shown in blue. LTCF, long-term care facility.

methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), and *Clostridium difficile* using previously reported methods.[5]

To assess the potential for wheelchairs to disseminate pathogens, we used data from hospital transport personnel log books during a 3-day period to develop a network graph of wheelchair movement within the facility. Data from the log books were translated to directed graph edges, noting the precise medical center locations documented in logs and grouping locations based on the location within the medical center and/or the type of care. Acute care and LTCF wards were classified as inpatient settings; specialty care and primary care clinics were classified as outpatient settings; and radiology, pharmacy, physical/occupational therapy, and the main entrance/parking garage were classified as other settings. The data were then presented as a network graph using the igraph package (version 1.1.2) in R software (version 3.4.3; R Foundation for Statistical Computing, Vienna, Austria). The nodes were color-coded according to setting.

RESULTS

Of the 40 wheelchairs cultured, 12 (30%) had 1 or more pathogens recovered from the wheels, including 10 (25%) *C difficile*, 1 (3%) MRSA, and 1 (3%) VRE. Of the 40 wheelchairs cultured, 12 (30%) had 1 or more pathogens recovered from the body of the chair, including 7 (18%) *C difficile*, 2 (5%) MRSA, and 4 (10%) VRE. Eight of the wheelchairs had 1 or more pathogens recovered from both the wheels and the body of the chair.

During the 3-day period when wheelchair transport was evaluated, there were 851 assisted patient transports with wheelchairs (284 transports per day). Of the 851 transports, 230 (27%) involved transport to or from an inpatient setting without including an outpatient origin or destination, 280 (33%) involved transport to or from an outpatient setting without including an inpatient origin or destination, 298 (35%) involved transport between inpatient and outpatient settings, and 43 (5%) did not include an inpatient or outpatient origin or destination (ie, transport between sites classified as other settings including radiology, pharmacy, physical/occupational therapy, and the main entrance/parking garage). Figure 1 shows the network graph of wheelchair movement within the facility with trips, including inpatient origins or destinations shown in yellow and all other trips shown in blue. For LTCF residents, the most frequent site of transport was physical/occupational therapy. For acute care patients, the most frequent site of transport was radiology. Outpatients were frequently transported between the main entrance/parking lot and primary or specialty care clinics with less frequent trips between the main entrance/parking lot and radiology or physical/occupational therapy.

DISCUSSION

We found that the body and wheels of shared-use wheelchairs in our facility were often contaminated with healthcare–associated pathogens. *C difficile* was the most frequent pathogen recovered, possibly due in part to the fact that the disinfectant wipes used to clean wheelchairs do not have activity against *C difficile* spores. Although such nonsporicidal wipes reduce spores on contaminated surfaces through mechanical removal, they also may transfer spores from contaminated to clean surfaces.[9] Shared wheelchairs were frequently used to transport patients (mean, 284 transports per day), and they traveled widely throughout the facility. These findings suggest that

shared-use wheelchairs could serve as an underappreciated source for transmission of healthcare–associated pathogens.

Our network graph highlights the fact that movements of inpatients and outpatients often intersect in areas such as radiology and specialty care clinics. Such intersection might provide opportunities for acquisition of healthcare–associated pathogens by outpatients with no prior hospital or LTCF stay. In a recent study involving spatial and temporal mapping of patient movement, passing through a computed tomography scanner in the emergency department after a patient with *Clostridium difficile* infection (CDI) was associated with increased risk of developing CDI.[10] Exposure to a wheelchair previously occupied by a CDI patient could theoretically result in a similar increase in the risk for CDI in the absence of shared exposure in the same hospital location.

Our study has some limitations. Only 1 medical center was included. Findings might differ in other settings. We did not assess compliance with our facility policy that wheelchairs should be wiped daily with a disinfectant wipe and as needed throughout the day if they become soiled. Additional studies are needed because our findings suggest but do not prove that shared wheelchairs might contribute to pathogen transmission. Finally, our study focused only on shared-use wheelchairs. It is plausible that wheelchairs dedicated to individuals could facilitate transfer of pathogens from healthcare facility floors to the hands of patients who self-propel their
wheelchairs.

CONCLUSIONS

There is a need for effective strategies to ensure adequate cleaning and disinfection of wheelchairs. As noted previously, some method of monitoring cleaning practices is necessary, as written protocols are not likely to be sufficient.[4,7] Given that *C difficile* was the pathogen recovered most frequently in our culture survey, enhanced cleaning after transport of CDI patients may be particularly important, either with use of a sporicidal disinfectant or with use of multiple wipes to facilitate mechanical removal of spores.

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