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Marc-Oliver Wright, MT (ASCP), MS, CIC, FAPIC;[1]
Emmanuel Sampene, PhD;[2]
Nasia Safdar, MD, PhD[2,3]

Affiliations: 1. University of Wisconsin Hospitals and Clinics, Madison, Wisconsin; 2. University of Wisconsin School of Medicine and Public Health Madison, Wisconsin; 3. William S Middleton Memorial Veterans Hospital, Madison, Wisconsin.

Address correspondence to Marc-Oliver Wright, University of Wisconsin Hospitals and Clinics, Madison, WI (mwright@uwhealth.org).

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Self-monitoring by Environmental Services May Not Accurately Measure Thoroughness of Hospital Room Cleaning

The hospital environment and environmental contamination are increasingly emphasized in the prevention of healthcare-associated infection.[1] Appropriate cleaning and disinfection of the hospital environment has emerged as a key infection prevention strategy, yet environmental services (EVS) personnel often fail to clean and disinfect all surfaces in hospital rooms.[2] Consequently, the Centers for Disease Control and Prevention (CDC) recommends that all hospitals perform objective monitoring of environmental cleaning and disinfection.[3] More specifically, the CDC tool kit emphasizes that monitoring should be performed by hospital epidemiologists or infection preventionists who are not part of EVS to reduce the likelihood of surveillance bias and to assure the validity of results. To date, however, few if any studies have compared monitoring results of EVS and non-EVS personnel.

We performed this study to compare cleaning compliance data collected by EVS supervisors with parallel cleaning compliance data collected by study personnel. This study was completed during the Benefits of Enhanced Terminal Room (BETR) disinfection study, a large, multicenter randomized controlled trial comparing terminal disinfection strategies.[4] As part of the BETR disinfection study, EVS supervisors placed a fluorescent mark (DAZO, Ecolab, St Paul, MN) on 5–7 "high-touch" room surfaces prior to terminal cleaning in 10–15 rooms per week in each study hospital and examined the marks with a black light after cleaning.[5] If the fluorescent mark was no longer visible or had been smeared, the surface was considered to have been cleaned. Otherwise, the surface was considered not to have been cleaned.

While EVS supervisors performed this routine monitoring with fluorescent markers during the trial, study personnel independently collected parallel cleaning data at 2 study hospitals (1 tertiary care center and 1 community hospital). Study personnel tested a convenience sample of rooms from April through June 2014 (hereafter called the validation data). These rooms were then matched to rooms tested by EVS supervisors by unit (or type of unit), date of cleaning (same week), and EVS shift (time of day). Both the overall proportion of cleaned surfaces and the cleanliness of the 6 most-tested surfaces (bathroom handrail, door knobs, light switches, toilet seat, sink and chair) were compared between the EVS group and the validation group. Proportions were compared using the 2-tailed χ^2 test.

Study personnel collected cleaning thoroughness data in 56 rooms at the 2 study hospitals during the study period. EVS supervisors performed objective monitoring of room cleaning in 256 rooms in the 2 study hospitals during this period; 56 of these rooms were matched to compare monitoring by study personnel. Significant differences in surveillance results

TABLE 1. Comparison of Room Surfaces Considered "Clean" by Environmental Services (EVS) Personnel and External Validators

Rooms and Surfaces Tested	EVS, n/N (%)	Validation, n/N (%)	*P* Value
Total surfaces cleaned	264/320 (82.5)	153/292 (52.4)	<.001
Top 6 surfaces monitored			
Bathroom handrail by toilet	17/23 (73.9)	6/14 (42.9)	.062
Room/Bathroom door knob	19/21 (90.5)	3/13 (23.1)	<.001
Room/Bathroom light switch	20/21 (95.2)	5/21 (23.8)	<.001
Toilet seat	21/23 (91.3)	10/15 (66.7)	.059
Room sink	21/26 (80.8)	25/32 (78.1)	.806
Chair arm/seat	40/51 (78.4)	12/21 (57.1)	.069

were observed between the 2 methods (Table 1). Overall, EVS supervisors determined that 82.5% (264 of 320) of the surfaces had been cleaned, whereas validation testing found 52.4% (153 of 292) of surfaces had been cleaned ($P < .001$). Differences were also observed in specific surfaces being monitored, particularly door knobs and light switches. Results were generally similar between the 2 study hospitals (data not shown).

Our prospective, multicenter study demonstrated that room cleaning compliance data varied by the type of observer. We observed a difference of ~30% between rooms observed by EVS supervisors and rooms observed by our study personnel. As a result, our data support the recommendations made in the CDC's tool kit to have independent observers conduct objective room monitoring instead of internal EVS staff.[3] Also as the tool kit suggests, EVS must be involved in cleanliness monitoring programs to provide feedback and implement improved cleaning practices.

EVS and study personnel used fluorescent markers to monitor room cleaning. While feedback of data collected using this approach improves cleaning compliance,[2,6] it is unclear whether our results can be generalized to other methods of objective monitoring such as those using adenosine triphosphate (ATP) or UV powder.[7] We suspect, however, that surveillance bias could be a potential issue regardless of the specific method of monitoring cleaning.[8]

Our study had limitations. First, our convenience sample of validated rooms was small. However, we tested 612 individual surfaces, which was ample to achieve statistical significance between monitoring by EVS and study personnel. Second, some discrepancy may have been observed because of real-time feedback from EVS supervisors regarding missed spots and the need to re-clean the room. Thus, the EVS cleaning data may have been artificially elevated by including data after additional cleaning. Third, our independent observers were study personnel; we are unable to conclude whether infection prevention observers would find similar results, as it is well documented that type of the hand hygiene observer can affect surveillance data results.[9] Finally, we were not able to test rooms with both observers concurrently. Thus, our results can only offer general conclusions about the discrepancy between the 2 methods. However, we believe our strategy for matching rooms based on unit, date, and time strengthen our conclusions.

Our findings validate the recommendations in the CDC tool kit that independent observers should be used to achieve the most objective approach to monitoring. If not feasible for all monitoring, consideration should be given to selective sampling of rooms by external observers as a method to validate EVS monitoring. Similar to hand hygiene, external validation of room cleaning improves the validity of cleaning surveillance data. Feedback of validated data to EVS personnel may improve terminal cleaning and decrease the risk of bacterial transmission between patients.

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Lauren P. Knelson, MSPH;[1]
Gemila K. Ramadanovic, LPN;[1]
Luke F. Chen, MBBS, MPH, MBA CIC, FRACP FIDSA, FSHEA;[1]
Rebekah W. Moehring, MD, MPH;[2]
Sarah S. Lewis, MD MPH;[1]
William A. Rutala, PhD, MPH, FSHEA;[3]
David J. Weber, MD, MPH, FIDSA, FSHEA;[3]
Daniel J. Sexton, MD, FIDSA, FSHEA;[1]
Deverick J. Anderson, MD, MPH, FIDSA, FSHEA;[1]
and the The CDC Prevention EpiCenters Program

Affiliations: 1. Duke Infection Control Outreach Network, Division of Infectious Diseases, Duke University Medical Center, Durham, North Carolina; 2. Durham Veterans Affairs Medical Center, Durham, North Carolina; 3. Department of Hospital Epidemiology, University of North Carolina Health Care, Chapel Hill, Durham, North Carolina.

Address correspondence to Lauren P. Knelson, MSPH, Duke Infection Control Outreach Network, Division of Infectious Diseases, Duke University Medical Center, 330 Trent Drive, Durham, NC 27710 (laurenpknelson@gmail.com).

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An Evaluation of the Prevalence of Vancomycin-Resistant *Enterococci* (VRE) and Methicillin-Resistant *Staphylococcus aureus* (MRSA) in Hospital Food

Methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococci* (VRE) are associated with significant patient morbidity and mortality.[1] MRSA and VRE have been found in retail foods, primarily animal products,[2–6] but the role of hospital food in MRSA and VRE transmission in healthcare facilities is unknown. The purpose of this study was to determine the prevalence of MRSA and VRE in hospital food, with an emphasis on foods consumed by hospital patients.

METHODS

This prospective cohort study was conducted at Barnes-Jewish Hospital, a 1,250 bed tertiary care center in St Louis, Missouri, from May 2011 through July 2012 in conjunction with a study of *Clostridium difficile* in hospital food.[7] Our methods were described previously.[7,8] Briefly, patients on medical and surgical wards collected food samples from their meals in sterile specimen cups (1 cup per meal; ≥1 food item per cup) to ensure that the foods sampled were those consumed by patients. Food specimens were frozen at −30°C. Prior to culture, specimens were thawed, combined with 10 mL sterile water, and homogenized for 1 minute. A 1 mL volume of food homogenate was added to TSB broth with 6.5% NaCl; then the mixture was incubated overnight at 35°C. The broth was subcultured on sheep blood agar (Hardy Diagnostics, Santa Maria, CA), Spectra MRSA (Remel Diagnostics, Lenexa, KS), and chromID VRE (bioMèrieux, Marcy-l'Étoile, France). The Vitek matrix-assisted laser desorption/ionization time-of-flight mass spectroscopy (MALDI-TOF MS, bioMèrieux, Marcy-l'Étoile, France) method was utilized to identify *S. aureus* or *Enterococcus* spp. Susceptibility testing was performed using Kirby Bauer disk diffusion in accordance with CLSI standards,[9] and SCC*mec* typing was performed.[10]

Data were collected from patient interviews, chart review, and medical informatics queries, including MRSA and VRE clinical laboratory results from 1 year before enrollment to 1 year after enrollment. Descriptive data analyses were performed using SPSS version 21 software (IBM, Armonk, NY). The Washington University Institutional Review Board approved the study.

RESULTS

In total, 149 patients were enrolled in the study and 910 food specimens were collected (median, 5 specimens per patient; range, 1–24 specimens). The median patient age was 55 years (range, 23–90 years); 80 patients (54%) were female. 8 patients (5%) had clinical cultures (infection and/or surveillance) positive for MRSA, and 7 patients (5%) had clinical cultures positive for VRE, in the year before enrollment.

Overall, 1 or more food specimens from 17 patients (11%) were positive for MRSA, and 1 or more food specimens from 17 patients (11%) were positive for VRE. MRSA was cultured from 29 specimens (3.2%), and VRE was cultured from 22 specimens (2.4%); more than 1 positive specimen was collected from some patients. Of the 29 MRSA-positive isolates, 9 (31%) were SCC*mec* II, 2 (7%) were SCC*mec* III, and 18 (62%) were SCC*mec* IV. Notably, 7 SCC*mec* IV isolates came from a single patient (ie, 39% of SCC*mec* IV isolates). MRSA and VRE were cultured from every food category except nuts (Table 1). VRE was recovered from 5% of dairy or egg specimens and MRSA was recovered from 5% of bread or grain specimens and "other" specimens; for all other foods, the culture positivity rate was <5%.

Only 4 patients (3%) had a clinical culture positive for MRSA or VRE after having positive food without a previous