Addressing Bacterial Surface Contamination in Radiology Work Spaces

Alexander Harvin, MD, Kyle VanMiddlesworth, DO, Jonathan Botstein, MD, Robert Hazelrigg, MD, Jeanne Hill, MD, Paul Thacker, MD

Hospital-acquired and health care-related infections remain a significant problem throughout nearly all avenues of health care. Infection not only can lead to patient suffering and death but also can result in significant medical costs. One recent study estimated that Americans spend approximately $10 billion every year to treat the five most common hospital-acquired infections, with at least 50% of these infections deemed preventable [1]. Most hospital-acquired infections are postulated to result from direct contact with health care workers, but bacterial burden of horizontal surfaces is also a significant contributor [2-4]. Thus, there has been an increased focus on the spread of infectious organisms over hospital touch surfaces.

Problematic pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* have demonstrated survival for up to several months on both plastic and metallic surfaces [4-7]. These surfaces are ubiquitous in health care facilities, and many of these surfaces are frequently touched but infrequently cleaned. With infrequent cleaning and prolonged bacterial viability on said surfaces, there is an increased chance of transmission from patient to health care worker or vice versa. Numerous studies have illuminated the role of surface contamination in hospital-acquired infection and have shown significant decreases in patient colonization and infection rates by reducing surface contamination [3,4,8]. Thus, efforts should be made to reduce surface contamination where possible.

Like many, our radiology department plays significant roles in both diagnostic and therapeutic endeavors; thus, it is not surprising that there has been an increased interest in evaluating surface contamination of radiology and other hospital workstations [9-12]. One study focusing on endoscopy suite surfaces demonstrated primarily nonpathogenic organisms [12]. The highest rates of contamination involved physician keyboards, nurse carts, and nurse computer mice. Another recent study found several reading room workstations exhibiting similar levels of contamination to that of nearby toilet seats, with gram-negative rods (GNR) representing some of the contaminants [9]. We decided to expand upon these ideas by focusing on multiple departmental surfaces and compare levels of bacterial contamination to existing institutional intensive care unit (ICU) data [3,4]. We felt that having an existing internal data set from an ICU setting would serve as a baseline for a "high-risk" setting and provide insight into the severity of radiology department surface contamination. Additionally, given frequent interactions among patients, physicians, technologists, and equipment between the ICU and radiology areas, we were also curious as to the differences in bacterial flora between these two spaces. Thus, in addition to quantifying the bacterial burden, we decided to screen for problematic organisms, including MRSA, vancomycin-resistant enterococci (VRE), and GNR. Most importantly, as part of a resident-led quality improvement project, we hoped to educate residents, faculty, and staff on surface contamination and evaluate for improvement in surface contamination over a 6-month interval.

WHAT WAS DONE

Using well-established methods for accurately collecting and characterizing organisms from a horizontal surface, we performed a quantitative and qualitative assessment to determine both the degree of bacterial burden and the presence of problematic organisms, including MRSA, VRE, and GNR [4,13]. A preliminary sampling of a commonly used workstation was performed to determine which three surfaces yielded the highest bacterial count. The selected surfaces (dictation microphone, telephone,

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and space bar) were measured for surface area (cm^2) and, during resident conference hours, swabbed on the 10 most commonly used resident workstations (ie, one ultrasound, one nuclear medicine, two interventional, two musculoskeletal, two pediatric, and two abdominal workstations). Surfaces were similarly selected at technologist workstations (space bar, mouse left click button, and phone headset). Additional "modality-specific" surfaces were selected, including portions of radiographic cassettes, exposure buttons, fluoroscopy handles, ultrasound probes, and control panels. Telephone headsets from nearby workstations were cleaned with a bactericidal wipe and swabbed to serve as a "postcleaning" negative control to ensure sterilization of collection materials. Positive controls of standardized isolates were used for evaluation of growth media. Using sterile technique, swabs were agitated for extraction of organisms, which were plated for colony counts and speciation/phenotyping in accordance with previously described methods [4]. Bacterial burden was expressed in terms of total colony counts in colony-forming units per square centimeter (CFU/cm^2), with the commonly accepted level of benignity defined as less than 2.5 CFU/cm^2 for total bacteria and 1 CFU/cm^2 for pathogens such as MRSA/VRE [4,13].

As an intervention, we formally presented the data from our initial surface sampling to all radiology residents, faculty, and technologists in the form of 10-minute oral presentations. Additionally, digital and hard-copy visual reminders were posted in all pertinent technologist and resident areas. All workstations and imaging areas were kept fully stocked with cleaning supplies and routinely monitored for inventory. A repeat bacterial sampling was performed in six months, again during resident conference. None of the residents were made aware of the follow-up sampling, with the exception of those designated to perform swabbing. Of note, none of the residents performing sampling were assigned to the experimental workstations during the month of follow-up sampling.

Statistical analysis included determining median and mean bacterial concentration along with corresponding standard deviations. Given non-normal distribution of data, a nonparametric analysis (Wilcoxon's signed-rank test) was performed for comparison of initial and postintervention surface contamination. A χ^2 analysis was performed to compare the number of stations meeting the standard for surface contamination before and after intervention.

OUTCOMES

The initial bacterial survey of the 10 resident workstations demonstrated levels of overall microbial burden (MB) over commonly acceptable levels (<2.5 CFU/cm^2) on approximately 90% of surfaces (Fig. 1). The highest overall MB was seen on space bars, with an average MB of 25 ± 3 CFU/cm^2 (Figs. 1 and 2). Initial overall MB for all sampled workstation surfaces averaged 21 CFU/cm^2, almost 10 times that of acceptable levels. Staphylococci represented 71% of these organisms. Follow-up swabbing of these stations at six months demonstrated a significant decrease in total MB, averaging 10 CFU/cm^2 (Fig. 1) ($P = .04$). However, approximately 80% of surfaces still demonstrated contamination beyond acceptable levels, not significantly changed from the initial surface sampling ($P = .66$).

The initial bacterial survey of the technologist workstations demonstrated approximately 63% of

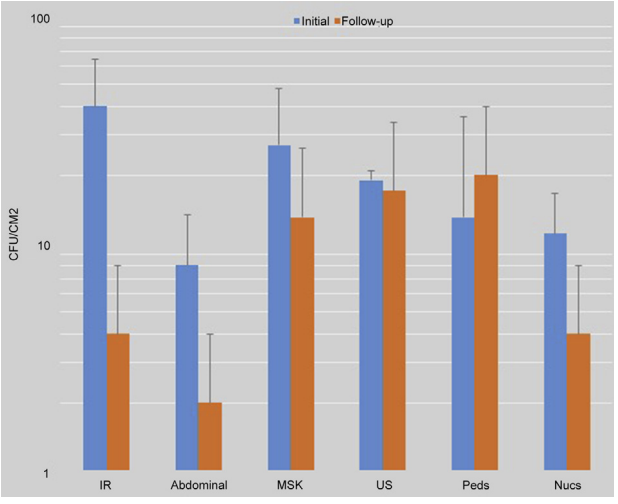

Fig 1. Mean colony counts in colony-forming units per cm^2 (CFU/cm^2) from 10 sampled resident workstations including 1 ultrasound (US), 1 nuclear medicine (Nucs), 2 interventional (IR), 2 musculoskeletal (MSK), 2 pediatric (Peds), and 2 abdominal workstations. The blue bars represent the initial bacterial survey and the red bars represent follow-up bacterial survey 6 months after educational intervention. Brackets represent standard deviations.