Editors' Commentary

How Important Is the Environment in the Emergence of Nosocomial Antimicrobial-Resistant Bacteria?

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(See the article by Drees et al. on pages 678–85)

Antimicrobial-resistant bacteria are an emerging problem globally and are associated with increased patient morbidity and mortality. Within hospitals, antibiotic-resistant bacteria continue to increase in incidence. As evidenced by the Centers for Disease Control and Prevention National Healthcare Safety Network collection of data across a large number of hospitals, resistance rates for vancomycin-resistant enterococci (VRE), methicillin-resistant Staphylococcus aureus, imipenem-resistant Pseudomonas aeruginosa, and cephalosporin-resistant Escherichia coli and Klebsiella species continue to increase [1]. These increases in antibiotic-resistant bacteria continue to occur despite efforts to contain them by numerous parties, including the Centers for Disease Control and Prevention, Veterans Health Administration, public interest groups, quality improvement administrators, antimicrobial stewardship teams, and hospital epidemiologists.

Figure 1 is a theoretical model that demonstrates a number of potential causal variables leading to the acquisition of antibiotic-resistant bacteria by patients [2]. These causal variables are divided into individual-level factors and facility-level factors. The relative importance of causal variables, such as antibiotic selective pressure and patient-to-patient transmission, are not definitely known for most antibiotic-resistant bacteria. In addition, their relative importance likely differs for different antibiotic-resistant bacterial species [3, 4]. For organisms such as methicillin-resistant S. aureus, VRE, and extended-spectrum β-lactamase–producing bacteria, patient-to-patient transmission via healthcare workers’ hands is thought to be an important cause of the increasing incidence of these antibiotic-resistant bacteria [4–6]. However, the role of environmental contamination in contributing to patient-to-patient transmission is a hotly disputed topic [7, 8].

Numerous studies have demonstrated that the environment of a patient’s room can become colonized with bacteria, such as Acinetobacter species, VRE, Clostridium difficile, and methicillin-resistant S. aureus, as well as with viruses, such as influenza virus and norovirus [8]. But the importance of this colonization in leading to patient-to-patient transmission has not been shown with a high level of scientific evidence. Problems with previous studies have included the following: (1) many were performed in an outbreak setting; (2) when environmental intervention studies have been done, they often have been of a lower-level quasi-experimental study design [9]; and (3) few studies have used molecular epidemiology (e.g., PFGE) to link environmental isolates to patient isolates. Recently, a couple of methodologically improved studies found that the environment may be important in the hospital acquisition of VRE. A study by Huang et al. [10] demonstrated that patients admitted to rooms that had previously been occupied by VRE-positive patients were more likely to acquire VRE. A limitation of this prior study was that it did not involve any specimen collection or molecular analysis; thus, it might be patient-to-patient transmission from surrounding patients and not the environment that is the primary risk factor. Hayden et al. [11] used an upper-level quasi-experimental design with a washout period and observed that an educational intervention aimed at improving environmental cleaning of rooms was associated with a decrease in VRE acquisition.

Against this background, in this issue of Clinical Infectious Diseases, Drees et al. [12] provide data that support the hypothesis that the environment may be important in the acquisition of VRE. These kinds of studies are very difficult to perform from a study design point of view because of the large number of confound-
Figure 1. Factors that influence the acquisition of a nosocomial antibiotic-resistant bacterial infection

In the study, the authors observed that a VRE-colonized prior room occupant (hazard ratio, 3.8; 95% CI, 2.0–7.4) and previous positive room cultures for VRE (hazard ratio, 4.4; 95% CI, 1.5–12.8) were risk factors for acquiring VRE when important confounding variables were controlled for. One limitation is that the study did not use molecular epidemiological techniques such as pulsed-field gel electrophoresis and thus the authors were unable to definitively show that environmental cultures obtained before a patient’s occupancy of the room were the same VRE strain as cultures obtained from active surveillance cultures of the patient. Another limitation is that despite the long duration of study and the numerous cultures obtained, there were still only 50 patients who acquired VRE. It is important to note that colonization pressure representing the average number of other VRE-positive patients in the unit was also an important risk factor, and this emphasizes the continued need to improve hand disinfection compliance and other standard infection control practices.

The authors make a number of important and appropriate conclusions in their discussion. They conclude that increased attention to environmental disinfection is warranted. They also conclude that their data do not support the routine use of environmental culturing as part of infection control. One of the reasons that they make this latter recommendation is the small frequency of positive environmental culture results in their study. Despite collecting 1220 environmental culture samples, only 67 yielded positive results. These data suggest that routine sampling of environmental sites is not likely a cost-effective intervention.

Potential environmental control interventions need further study before they should be adopted by hospital epidemiologists. On a broader intervention view, hospital epidemiologists are often faced with a limited budget to launch interventions aimed at decreasing antimicrobial-resistant bacteria. The relative merit and cost-effectiveness of different interventions, including antimicrobial stewardship, hand disinfection, active surveillance, and environmental disinfection, have yet to be fully determined [13]. Future research is needed to perform these intervention studies using upper-level quasi-experimental and randomized cluster designs. This research will help prioritize future interventions aimed at decreasing the emergence of antimicrobial resistance.

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References