

The Changing Role of the Healthcare Environment

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LEARNING OBJECTIVES:

1. Describe the role of the healthcare environment in its contribution to acquisition and transfer of microorganisms.
2. Discuss the role the environment has related to the risk of infection and illness in both patient and healthcare worker populations.
3. Summarize recently published scientific evidence related to transmission of microbes from environmental surfaces including textiles.
4. Explore laundering practices and procedures of healthcare textiles and uniforms.
5. Discuss new technologies and programs that can address reducing risk associated with contaminated environmental surfaces.

ABBREVIATIONS: ACHA – American College of Healthcare Architects, AHE - Association for the Healthcare Environment, CRE - carbapenem-resistant Enterobacteriaceae, CDC – Centers for Disease Control and Prevention, CDI – *Clostridium difficile* Infection, CFU – Colony Forming Units, EVS – Environmental Services, FDA - Food and Drug Administration, HCW – Healthcare Worker, HICPAC – Healthcare Infection Control Practices Advisory Committee, MDRO – Multiple Drug Resistant Organisms, MRSA – Methicillin Resistant *Staphylococcus aureus*, OR – Operating Room, OSHA - Occupational Safety and Health Administration, PPE – Personal Protective Equipment, VRE - Vancomycin-resistant *Enterococci*

INDEX TERMS: Antibiotic resistance, *C. difficile*, CDI, Healthcare-associated Infections (HAI), Healthcare worker safety, Multiple drug resistant organisms, MDROs, MRSA, Occupationally Acquired Infections (OAI), Patient safety, Personal Protective Equipment (PPE), Engineering Controls

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INTRODUCTION

The role of the healthcare environment and its contribution to acquisition and transfer of microorganisms that cause infection and illness in both patients and healthcare workers is not by any means straightforward. Considerations include potential contamination of hard surfaces like desks, sinks, beds, light switches, carts, walls, and floors, as well as porous surfaces like wheelchairs, bedding, linen, curtains, and upholstery. Historically the focus on managing the role of environmental variables was considered less critical because we knew less about the impact those surfaces had in infection prevention.

Several factors are now monitored within healthcare settings that are considered environmental controls. One of the primary areas includes environmental surfaces. These have been categorized by the Spaulding Classification as “noncritical items” or those that do not come into contact with a patient’s vascular system or body cavities, but rather simply by a brief or momentary touch from a patient or healthcare worker.¹

Critical or semi-critical items, in contrast to environmental or touch surfaces, are medical devices that are either implanted into a patient like joints, stints or other devices used during medical or surgical procedures like scalpels, endoscopes or probes that are in contact with a patient for minutes, hours, weeks, or years. These items pose a higher risk than noncritical items because they come into direct contact with a patient’s blood or body fluids. This year, the U.S. witnessed how improper cleaning and disinfection or sterilization of medical devices like endoscopes can result in serious patient illness and infection, even death. U.S. health officials issued a safety warning describing specialty endoscopes that were linked to the transmission of a drug-resistant superbug known as carbapenem-resistant Enterobacteriaceae (CRE) because they were improperly processed between patients. This resulted in stricter safety parameters established by the U.S. Food and Drug Administration.²

Due to the focus on these traditionally high risk items, noncritical items were often not considered as a paramount focus for cleaning and disinfection, other than for creating a general sense of cleanliness or sanitization. A long held perception was that if a healthcare facility (or environmental surface) smelled like bleach, then it must be clean. Now, the perception of cleanliness goes far beyond the residual scent of bleach. Clean does not always mean microbially clean or sterile.^{3,4}

The environmental surfaces in healthcare are complex. As more focus is placed on the overall experience a patient and his or her family, friends, and caregivers have during the continuum of care, the greater the concern becomes on the transformation of healthcare facilities into warm, inviting, and calming environments.^{5,6} This complexity means that there has been a progression over time from hard non-porous surfaces that are easy to clean and disinfect like

linoleum, stainless steel, tile, and stone to porous surfaces like carpets, textiles, and elaborate finishes. These porous surfaces are more difficult to clean, sanitize or disinfect because they provide crevices and nooks and crannies where microorganisms can live and propagate.

This complexity also means a growing and changing role for the teams that are responsible for protecting patients, providers, and visitors from contamination of surfaces – the environmental services (EVS) professionals. EVS professionals are a vital part of the healthcare team. Their work impacts many components of the daily operations of a facility including infection prevention and improved outcomes. Due to the fact that healthcare facilities are now recognizing the important role these functions play in the overall safety of the healthcare system, increased (and overdue) attention is being focused here and organizations like the Association for the Healthcare Environment (AHE) have competency-based models in place so that EVS can continue to be an essential aspect of the facility’s operations.^{3,4}

Surface Contamination

Microbes thrive on porous surfaces.⁷⁻⁹ Their vitality is due in part to their ability to live in and on high levels of bioburden or microbial load if there is a splash or splatter of blood or body fluid.¹ Outbreaks have been identified from porous surfaces like textiles in a variety of patient and worker populations in healthcare facilities around the world.¹⁰⁻¹²

As mentioned earlier, this becomes especially problematic when we consider that porous surfaces also include privacy curtains, linen, bedding, uniforms, and lab coats. Contaminated soft surfaces make an important contribution to the epidemic and endemic transmission of *Clostridium difficile*, Vancomycin-resistant Enterococci (VRE), MRSA, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and norovirus.^{7,8,13-19} These surfaces are often difficult to clean and nearly impossible to disinfect.

Ohl et al reported that 92% of hospital privacy curtains are rapidly contaminated within a week with potentially pathogenic bacteria, such as MRSA and VRE.²⁰ Microorganisms shed by patients can contaminate hospital surfaces at concentrations sufficient for

transmission.¹⁹ These pathogens survive and persist for extended periods despite attempts to disinfect or remove them, and can be transferred to healthcare workers' (HCWs') hands. In his paper, Otter states that the fact that contaminated surfaces contribute, "negligibly to nosocomial transmission is no longer valid given the new line of scientific evidence."¹⁹

Uniform Policies and Laundry Practices

Healthcare uniforms are a potential vehicle for transmission of microbes that cause infection and illness. Unfortunately, the U.S. lags behind many other countries, especially those in Europe, related to uniform policies and the acceptability of wear outside of the healthcare facility. In European countries, scrubs and lab coats are *not* permitted to be worn outside of the healthcare facility.²¹ This policy is in place to prevent transmission of healthcare-associated pathogens into the community. Due to the fact that HCWs often travel to and from facilities by way of public transportation, it can create a broader spectrum of exposure to possible environmental contaminants.^{19,22}

For some reason, the U.S. does not adhere to that logic. As such, in contrast to Europe, in the U.S., only scrub suits worn in the operating room (OR) by surgical staff and isolation gowns worn as personal protective equipment (PPE) are laundered by the healthcare facility. This strategy improves infection prevention and control and decreases the likelihood of organism transmission outside of healthcare facilities.

Healthcare facilities have the ability to follow the Centers for Disease Control and Prevention (CDC) recommendations for laundry and they are required to follow standards established by the Occupational Safety and Health Administration (OSHA) to protect workers from occupational exposure to soiled linen. CDC guidance for laundry includes the parameters that can be reached by industrial machines including the use of water temperatures of at least 160°F (70°C).²³ CDC recommends the use of 50-150 ppm of chlorine bleach to remove significant quantities of microorganisms from grossly contaminated linen. This is often not followed for uniforms being laundered at home because many scrub manufacturers actually discourage the use of bleach for fear of compromising the life of the dye or color. Most scrub suits, lab coats, and scrub jackets washed at home do not reach temperatures beyond

110°F (45°C) due to child scalding laws. High dryer temperatures as well as the physical agitation in both the wash and dry cycles may reduce pathogens to a low enough threshold to reduce infectivity, however this becomes problematic as many choose to either hand wash or hang dry items for various reasons.

Laundering contaminated uniforms at home may be problematic. In October 2009, there were three cases of *Gordonia bronchialis* sternal infections where a nurse anesthetist was identified as the source of the outbreak.²⁴ Four separate strains of *G. bronchialis* were isolated from her scrubs, axilla, hands, and purse. The strains were also identified in her home washing machine.

Nurses' uniforms laundered at home can result in the potential for transmission of microbes. In fact, several studies identify that those uniforms are contaminated with pathogenic bacteria including MRSA at the beginning of the work shift.^{9,25,26} In a study measuring nurses' uniform contamination, it showed an increase in contamination from 39% at the beginning of the work shift to 54% by the end of the day. Another analysis documented that 100% of nurses' gowns were contaminated within the first day of use, and 33% of those were contaminated with *S. aureus*. Pockets and cuffs may be the areas of highest microbial contamination.²⁷

Burden et al found that uniforms that were almost sterile prior to donning accumulated nearly 50% of their eight-hour measured colony forming units (CFU) after only three hours of wear.²⁶ Those researchers also found no significant difference in CFU cultured from previously-worn white coats versus newly laundered uniforms, sleeve cuffs of either type of garment, or the pockets of white coats versus uniforms. Results of the cultures showed 16% from the white coats and 20% from the short-sleeved uniforms were positive for MRSA. Burden concluded that reducing bacterial contamination of HCWs' clothing would require changing work clothes every few hours.

Focused Solutions

Due to the potential of contaminated textiles to provide a vector for transmission of organisms that cause infection or illness in patients or healthcare workers, more focus needs to be placed on the changing role of

the healthcare environment. This is true in hospitals, as well as ambulatory care, office-based clinics, surgical centers, rehabilitation facilities, long term care, dialysis centers, and even home care. This must include focus not just on high-touch, non-porous surfaces, but also on porous textured or textile surfaces.

The removal of bioburden or soil through the process of cleaning is critical for effective sanitization or disinfection. This means that careful attention is needed for cleaning or bioburden reduction - to significantly reduce blood and body fluid contamination – and sanitization or disinfection – to significantly reduce microorganisms and their ability to be infectious.^{1,23} We now know that the sense of a “clean” scent or smell historically used in healthcare settings is not good enough today, as it does not mean that the surface or garment is “microbially clean.”^{3,4}

In addition to facility-based focus on environmental cleaning and disinfection, laundering practices, and uniform/apparel policies, there are advances in technologies and engineering controls used in healthcare surfaces that can reduce bioburden and therefore reduce the likelihood of viable microorganisms. These advances include engineering the surfaces to create active barriers that are fluid repellent or resistant, as well as antimicrobial. When exploring these options, facilities must be sure to weigh the cost – benefit, as well as the scientific evidence for the effectiveness of the technology in a clinical setting.

Over time, we are getting smarter about the role of the environment in infection prevention. What we know now can prepare us for building smarter and better healthcare environments that do not pose an undue risk to the patients and providers that come into contact with them. Relying on the expertise of the environmental services professionals allows us to work together to provide safer, quality care.

Recommendations

- Consider the role that non-critical devices (environmental surface) play related to the transmission of microorganisms that cause infection and illness in both patient and healthcare worker (provider) populations. Pay close attention to procedures that address changing privacy curtains and uniforms.

- Identify if new construction or facility design has the potential to impact the ability of EVS to clean and/or disinfect environmental surfaces.
- Identify if old construction or facility design needs to be replaced so that surfaces are easier to clean and disinfect (e.g. carpeting, cracked/damages surfaces). Monitor how the facility addresses flooring, countertop, or furniture replacement.
- Identify if EVS leaders play an active role in a facility’s infection prevention, materials management, staffing, and patient safety committees.
- Review laundry practices and procedures to determine adherence to CDC Guidelines and OSHA Standards.
- Review uniform and PPE policies to minimize patient and worker exposures to contaminated garments. Just because garments appear clean does not mean that they are not capable of acquiring and transmitting infectious pathogens.
- Consider the evaluation and adoption of new technologies and engineering controls that may minimize patient and worker exposures to healthcare-associated pathogens.

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