

# **A REVIEW OF ENVIRONMENTAL HYGIENE REQUIREMENTS**

COMPLYING WITH INFECTION PREVENTION  
AND CONTROL ACCREDITATION PROGRAMS

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## INTRODUCTION

Cleaning and disinfecting environmental surfaces (environmental hygiene) in healthcare facilities is crucial for reducing healthcare-associated infections (HAIs) and improving patient outcomes.<sup>1</sup> Furthermore, healthcare organizations must comply with rigorous infection prevention and control standards to obtain accreditation from the Joint Commission and other agencies.<sup>1,2</sup> However, a recent survey by the Clean Spaces, Healthy Patients initiative of the Association for Professionals in Infection Control and Epidemiology (APIC) and the Association for the Healthcare Environment (AHE) found that around half of infection prevention and environmental services professionals find it difficult to locate useful resources about proper environmental hygiene practices, highlighting the need for additional education in this area.<sup>1</sup> The purpose of this white paper is to provide healthcare professionals with guidance on how to comply with IPC accreditation programs, as they pertain to environmental hygiene.

## THE IMPACT OF ENVIRONMENTAL HYGIENE ON HEALTHCARE-ASSOCIATED INFECTIONS

One of the most frequent, adverse events that occur during the treatment of other medical conditions and is associated with significant morbidity and mortality are HAIs. In the United States, an estimated 1.7 million HAIs occur in hospitals each year and these are associated with approximately 99,000 deaths. This equates to a rate of approximately 1 in 20 hospitalized patients who acquire an HAI during their hospitalization.<sup>3,4</sup> HAIs also place a high economic burden on the healthcare system, costing United States hospitals an estimated \$28.4 to \$45 billion per year.<sup>5</sup>

Some of the most prevalent healthcare-associated pathogens, including *Acinetobacter baumannii*, *Clostridium difficile*, *Escherichia coli*, *Pseudomonas aeruginosa*, methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE) and other multidrug-resistant organisms (MDROs), can survive on environmental surfaces for months.<sup>6</sup> Transfer of pathogenic microorganisms to patients typically occurs via the hands of healthcare staff, but can also occur directly from the environmental surface.

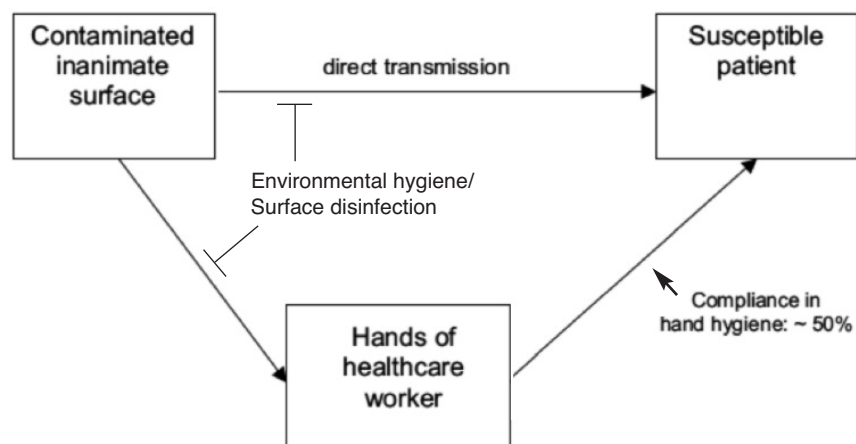
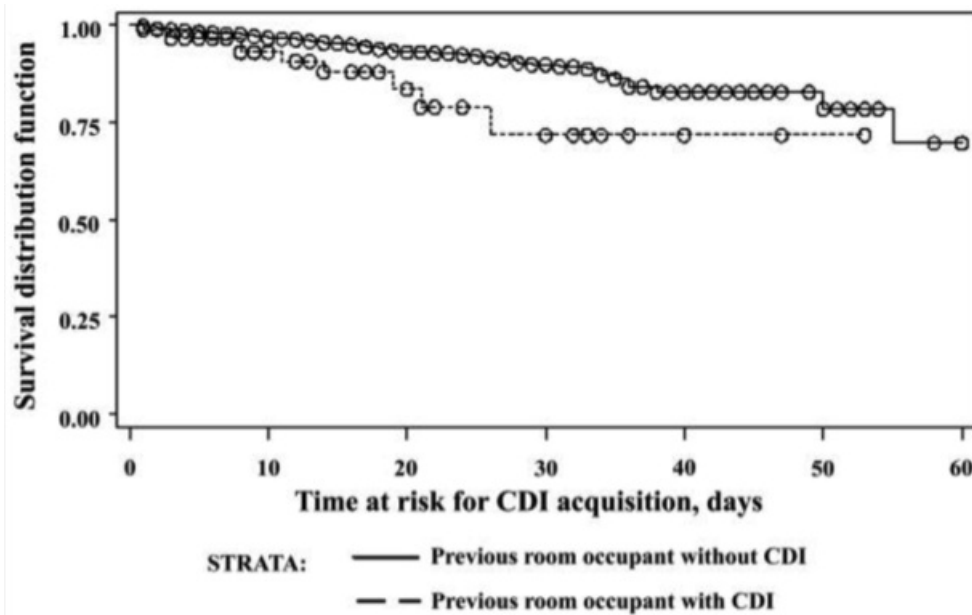


FIGURE 1. Modes of Transmission of Infectious Organisms from Environmental Surfaces to Susceptible Patients.

Adapted from Kramer, et al., 2006.<sup>6</sup>

It is estimated that 20-40% of HAIs result from transmission by a healthcare worker after touching either another patient or a contaminated environmental surface (Figure 1).<sup>7</sup> In addition, increasing evidence has been accumulated for the role of environmental surfaces in the transmission of infectious microorganisms. In fact, some of the most important healthcare-associated pathogens, including *Acinetobacter baumannii*, *Clostridium difficile*, *Escherichia coli*, *Pseudomonas aeruginosa*, methicillin resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *enterococci* (VRE) and other multidrug-resistant organisms (MDROs), can survive on environmental surfaces for months.<sup>6</sup>

Studies show patients are at higher risk of acquiring certain pathogens if they are admitted to a room previously occupied by infected or colonized patients.<sup>9</sup> For example, a recent study demonstrated that patients were significantly more likely to develop *C. difficile* infection if the prior occupant of the room had *C. difficile* infection, compared to patients with a prior room occupant negative for *C. difficile* infection (P = .008) (Figure 2).<sup>10</sup> *C. difficile* is the leading cause of healthcare-associated diarrhea and is an increasing cause of hospital morbidity, mortality and economic burden due to the emergence of a hypervirulent and resistant strain.<sup>10,11</sup> As a result, in its *Action Plan to Prevent Healthcare-Associated Infections*, the United States Department of Health and Human Services (HHS) pointed to the importance of environmental hygiene in the prevention of *C. difficile* infections.<sup>3</sup> Effective environmental hygiene solutions would also target other pathogens, such as MRSA and VRE, to help prevent HAIs as well as meet rigorous infection prevention requirements set by healthcare accreditation agencies.<sup>2,7,8</sup>



**FIGURE 2. Kaplan-Meier curve of *Clostridium difficile* infection (CDI) development.**

The survival distribution function indicates the absence of the development of CDI. The group with a prior room occupant with CDI was more likely to develop CDI (P = .008).<sup>10</sup>

## HOSPITAL ACCREDITATION

In order to establish and maintain high standards of IPC and reduce the risk of HAIs, healthcare organizations seek accreditation from agencies such as The Joint Commission, Healthcare Facilities Accreditation Program. Accreditation is an independent review process that determines whether a healthcare facility meets established standards. An on-site survey typically focuses on patient-centered processes to assess the safety and quality of care being provided.<sup>13</sup>

The Joint Commission is the largest accreditation agency in the United States and its Infection Control (IC) program places an emphasis on the prevention of infections, suggesting the importance of complying with standards that relate to environmental hygiene.<sup>2,13,14</sup> The Joint Commission IC standards are designed as a continuous process from planning (IC.01.01.01-IC.01.06.01), to implementation (IC.02.01.01-IC.02.04.01) and evaluation (IC.03.01.01).<sup>14</sup> Standards pertaining to environmental hygiene stipulate that the healthcare organization use evidence-based national guidelines or expert consensus to develop its IPC plan (IC.01.05.01, Element of Performance [EP] 1) and that the plan documents the activities that are subsequently used to minimize, reduce, or eliminate the risk of infection (IC.01.05.01, EP 2; IC.02.01.01, EP 1). Another important standard that relates to environmental hygiene requires that specific precautions be used to protect against exposure to a suspected or identified pathogen based on that pathogen's mode of transmission, including contact spread (IC.02.01.01, EP 3).<sup>15</sup> This standard carries a direct impact rating, meaning that noncompliance can directly impact the safety or quality of a patient's care. It also requires that a "Measure of Success" be provided during the survey process so that the surveyor can determine from the data whether the standard was effectively implemented.<sup>14,15</sup>

The Joint Commission's National Patient Safety Goals (NPSGs) aim to help healthcare organizations address their highest priority patient safety issues.<sup>16</sup> For example, infections caused by MDROs are of particular concern in hospitals today. Thus, NPSG.07.03.01 describes the practices that should be used to prevent these infections, including risk assessments (EP 1), education of healthcare staff, as well as patients and their families (EP 2,3), surveillance (EP 4), evaluation of processes and outcomes (EP 5,6) and alert system implementation (EP 8,9). Environmental hygiene is specifically addressed by the requirement that policies and practices based on evidence-based national guidelines be used to reduce the risk of transmitting MDROs (EP 7).<sup>17</sup>

## EPA-REGISTERED, HOSPITAL GRADE DISINFECTANTS

Because disinfectants are used in hospital settings to prevent or destroy pests (microorganisms), they are regulated as pesticides by the Antimicrobial Division in the EPA's Office of Pesticides Program under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). As such, they must be tested for safety and efficacy using established methods before they can be registered by the EPA for sale or distribution.<sup>21</sup>

The EPA regulates the labeling of disinfectants and requires the following items to be present on all labels: restricted use statement, if required; product name, brand or trademark; ingredient statement; "Keep Out of Reach of Children" statement; signal word, including "skull and crossbones" symbol and the word "poison," if required; first aid; net weight or measure of contents; EPA registration number and establishment number; company name and address; precautionary statements, including hazards to humans and environment; directions for use, including the misuse statement; storage and disposal; and worker protection. The directions for use portion of a disinfectant's label must be clearly written, so they can be easily understood and

followed. Directions for use include sites or surfaces where the disinfectant can be used and the microorganisms that can be effectively controlled at each site, information on how to prepare and handle the disinfectant, including dilution or mixing instructions and compatibility with other products and information on methods, timing, rates and frequency of application.<sup>22</sup>

Contact times are specified on the labels of EPA-registered disinfectants. Surfaces must be exposed to the disinfectant for the contact time listed, which can range anywhere from one to ten minutes depending on the disinfectant and target microorganism. In order to effectively control all microorganisms included on the product's label, the longest contact time must be utilized.<sup>21</sup> For all antimicrobial products used to control pathogens in the healthcare environment, the EPA also requires that each strain listed on the label be supported by appropriate efficacy data.<sup>22</sup> These efficacy claims can provide the basis for evaluation of new or existing disinfectants.<sup>8</sup> With MDROs continually emerging, the disinfectant should ideally have a broad antimicrobial spectrum.<sup>21</sup>

FIFRA requires that all label instructions on EPA-registered products be explicitly followed and any off-label use comes with the risk of enforcement action. This includes adhering to contact time, using with only compatible products and following dilution, application, storage and disposal instructions. Accreditation agencies will also assess for correct use of disinfectants and for staff education in this area. Therefore, reviewing disinfectant labels with staff is essential for ensuring that the appropriate products are being used correctly for all target microorganisms, as well as for successful accreditation.<sup>21</sup>

## **EVIDENCE-BASED APPROACHES TO ENVIRONMENTAL SURFACE DISINFECTION**

The CDC provides guidelines for the specific use of EPA-registered disinfectants in healthcare settings.<sup>21</sup> These guidelines should also be used to comply with IC standards and National Patient Safety Goals outlined by The Joint Commission.<sup>2,15,17</sup>

The CDC *Guideline for Disinfection and Sterilization in Healthcare Facilities*, 2008, begins by outlining the Spaulding classification scheme for patient-care items and equipment. Based on the potential for an item to transmit infection, it can be classified as critical, semicritical, or noncritical. Noncritical items are defined as such because they only come in contact with intact skin of the patient. Therefore, their sterility is not critical.<sup>21</sup> The CDC has added an additional noncritical category, environmental surfaces, which encompasses surfaces that typically do not make direct contact with patients. These surfaces can be further divided into housekeeping surfaces, such as bed rails, furniture, floors and walls and medical equipment surfaces, such as bedpans, blood pressure cuffs, instrument carts and knobs or handles on machines.<sup>21,23</sup>

Although environmental surfaces typically do not come into direct contact with patients, they can still become contaminated and contribute to transmission of infectious agents via the hands of healthcare staff.<sup>21,23</sup> For this reason, "high-touch" surfaces are considered to carry a higher risk of cross-infection than "low-touch" surfaces and should be cleaned and disinfected more often according to CDC guidelines.<sup>8,23</sup> Recently, high-, medium- and low-touch surfaces were quantified on a general medical-surgical floor and in an intensive care unit (ICU). High-touch surfaces were in close proximity to the patient and included bed rails, over-bed tables, IV pumps and bed surfaces on medical-surgical floors, accounting for 48.6% of contacts recorded (Figure 3). In ICUs, bed rails, bed surfaces and supply carts were high-touch surfaces, accounting for 40.2% of contacts recorded (Figure 4).<sup>9</sup> An organization's risk assessment and IPC plan should include similar studies of each area of the healthcare facility, allowing detailed cleaning and disinfecting protocols to be developed.<sup>9,23</sup>

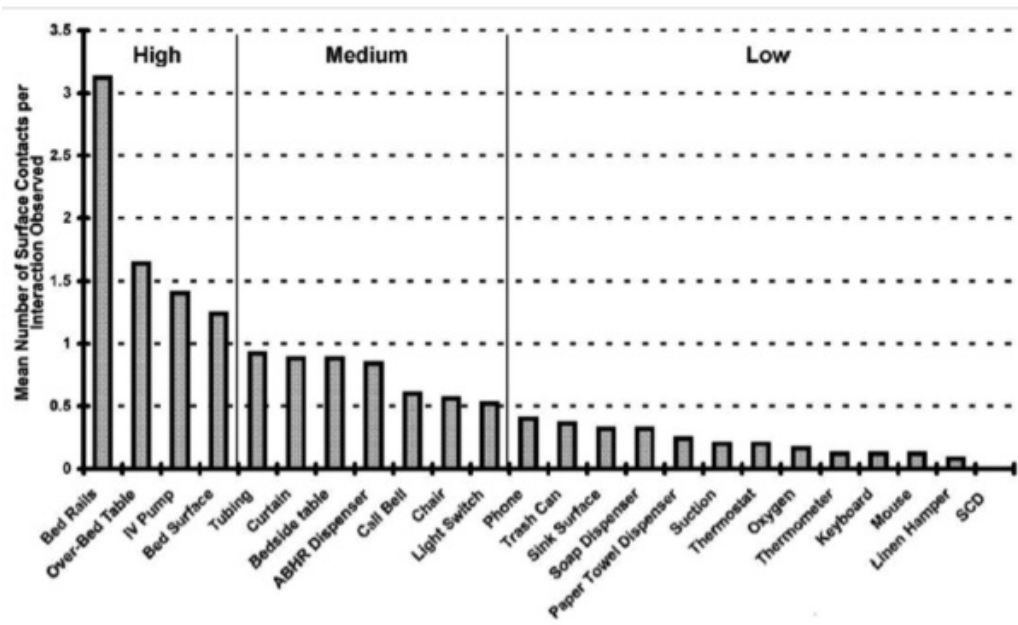


FIGURE 3. High-, medium- and low-touch surfaces on a general medical-surgical floor.<sup>9</sup>

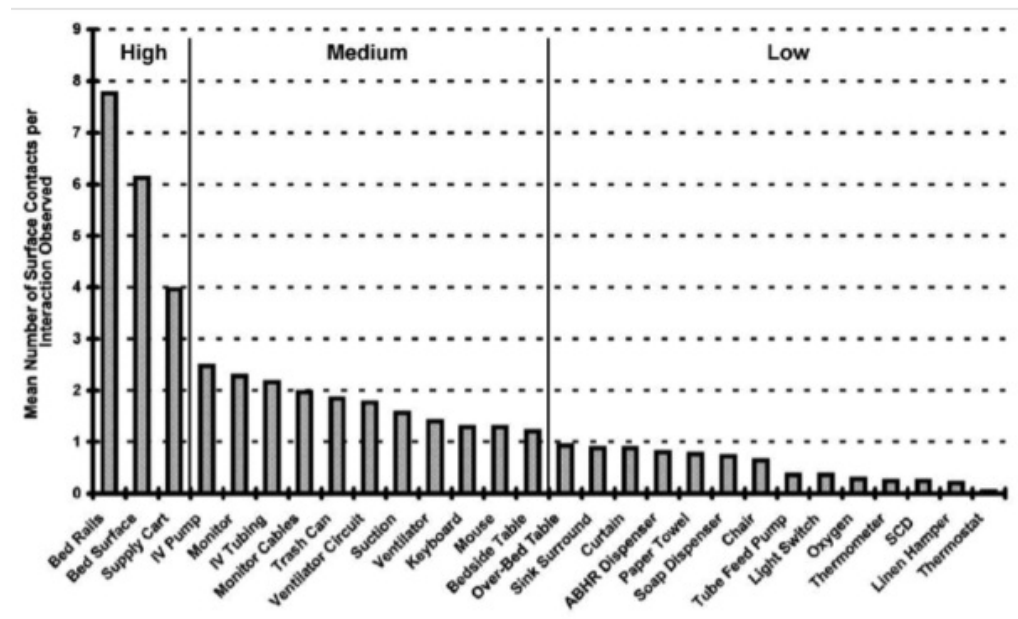


FIGURE 4. High-, medium- and low-touch surfaces in an intensive care unit.<sup>9</sup>

## EVIDENCE-BASED GUIDELINES – LEVELS OF DISINFECTION

Spaulding also proposed three levels of disinfection: high (sporicidal), intermediate (tuberculocidal) and low (Table 1). High-level disinfection with powerful, sporicidal chemicals is not appropriate or necessary for noncritical items.<sup>23</sup> Low-level disinfectants are suitable for most noncritical environmental surfaces, including both patient-care items and housekeeping surfaces and include the quaternary ammonium compounds, some iodophors and some phenolics.<sup>21,23</sup> In order to gain EPA registration, these hospital disinfectants have been tested for efficacy against *P. aeruginosa*, *S. aureus* and *Salmonella choleraesuis*.<sup>23</sup>

Intermediate-level disinfectants include the alcohols, hypochlorites, some iodophors and some phenolics. They are generally not able to kill bacterial spores, although dilute hypochlorite solutions are recommended for controlling *C. difficile*, which produces spores that are resistant to other commonly-used surface disinfectants.<sup>21,23</sup> All intermediate-level disinfectants are tuberculocidal. Although *Mycobacterium tuberculosis* is not transmitted by contact with environmental surfaces, it is more resistant to disinfectants than ordinary vegetative bacteria, fungi and viruses, so it was previously used as a benchmark for measuring germicidal activity. Intermediate-level disinfectants are capable of inactivating a broad range of microorganisms, including the bloodborne pathogens hepatitis B virus (HBV) and human immunodeficiency virus (HIV).<sup>23</sup> For this reason, the OSHA Bloodborne Pathogen Standard specifies that intermediate-level/tuberculocidal disinfectants be used to decontaminate environmental surfaces that have come in contact with blood or other potentially infectious body fluids. CDC guidelines recommend the use of a 1:100 dilution of an EPA-registered sodium hypochlorite solution for such an undertaking, but a 1:10 dilution should be used for initial inactivation of bloodborne viruses if a large spill has occurred. If the surface has not become highly contaminated and if HBV and HIV are the only concerns, then EPA-registered disinfectants that are labeled as effective against HBV and HIV are sufficient by OSHA standards.<sup>21,23,24</sup>

**TABLE 1. Levels of Disinfection According to Microorganism Resistance<sup>23</sup>**

| Disinfection Level | BACTERIA   |                                   |        | FUNGI | VIRUSES               |                         |
|--------------------|------------|-----------------------------------|--------|-------|-----------------------|-------------------------|
|                    | Vegetative | <i>Mycobacterium tuberculosis</i> | Spores |       | Lipid and medium size | Nonlipid and small size |
| High               | +          | +                                 | +      | +     | +                     | +                       |
| Intermediate       | +          | +                                 | -*     | +     | +                     | +**                     |
| Low                | +          | -                                 | -      | +     | +                     | +                       |

+ A killing effect can be expected when the normal use-concentrations of chemical disinfectants are properly employed; - Little or no killing effect.

\* Some intermediate-level disinfectants can exhibit some sporicidal activity (e.g., hypochlorites).

\*\* Although intermediate-level disinfectants are tuberculocidal, some may have limited virucidal activity.

The CDC's *Guidelines for Environmental Infection Control in Health-Care Facilities* recommend that, in the absence of manufacturers' instructions, noncritical medical equipment surfaces should be cleaned followed by low- to intermediate-level disinfection with an EPA-registered product, as per the label instructions. Barrier protection of equipment can be beneficial if the surfaces are frequently touched, at high risk of contamination, or awkward to clean. Housekeeping surfaces should be cleaned and/or disinfected regularly, when spills occur, when they are visibly dusty or soiled and when a patient is discharged from the room.<sup>23</sup> It is estimated that daily cleaning and disinfecting of patient rooms takes around 25-30 minutes per room and environmental hygiene procedures carried out at discharge can take 40-60 minutes per room.<sup>1</sup> For operating rooms, environmental hygiene procedures should be performed before the first patient of the day as well as after each patient.<sup>8</sup> Disinfection of floors, walls, blinds and curtains is generally not necessary. As already mentioned, high-touch surfaces require more frequent cleaning and/or disinfecting than low-touch surfaces. Disinfection alone should be carried out when infectious organisms are suspected or confirmed. Additionally, care needs to be taken to avoid contamination of cleaning tools and working solutions of detergents or disinfectants.<sup>23</sup>

A healthcare facility's IPC team should use these recommendations to develop detailed environmental hygiene schedules and methods that comprise part of their IPC plan.<sup>21</sup> These vary based on the surface types in each area and the degree of soiling or contamination that is likely.<sup>23</sup> The CDC guidelines should also be consulted when selecting disinfectants for environmental hygiene procedures. They provide information on efficacy and safety and make recommendations for which disinfectants to use for specific microorganisms and settings. Understanding and evaluating the main active ingredient of low- and intermediate-level disinfectants is essential to determining the best solution for each healthcare environment. These include: the alcohols, ethyl alcohol and isopropyl alcohol at 60-90% v/v; chlorine and chlorine compounds, such as the most commonly used 5.25-6.15% sodium hypochlorite (household bleach); hydrogen peroxide when used at low concentrations of 3-6%; iodophors; phenolics; and quaternary ammonium compounds.<sup>21</sup>

## CONCLUSION

In order to reduce the morbidity and mortality associated with HAIs and to comply with stringent IPC standards of accreditation agencies, environmental hygiene needs to become an integral part of daily routines in healthcare facilities. This includes regular risk assessments, real-time surveillance and thorough evaluation of the effectiveness of IPC programs that are run by multidisciplinary teams. Evidence-based guidelines also need to be followed to ensure that appropriate disinfectants are used for specific surfaces and microorganisms. Of particular importance is adherence to the label instructions of EPA-registered disinfectants, including dilution ratios and overall contact time required to kill pathogens. Healthcare organizations can obtain more information on the on-site survey process from accreditation agencies such as *The Joint Commission, which publishes a Survey Activity Guide for Health Care Organizations*<sup>18</sup>, as well as *The Joint Commission Infection Prevention and Control Handbook for Hospitals*<sup>20</sup> and *Infection Prevention and Control Issues in the Environment of Care*<sup>19</sup>. Other valuable resources include the Association for Professionals in Infection Control and Epidemiology, the Centers for Disease Control and Prevention, the Environmental Protection Agency, the Department of Health and Human Services and the Occupational Safety and Health Administration.

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