



Ryberg Omnia[®]

360 UV-C disinfection

Whitepaper:

Protecting Patient Health with UV-C;

Defeating the High Costs of HAIs

Autonomous.

Reliable.

Effective.

RYBERG OMNIA : ENGINEERED TO REDEFINE INFECTION PREVENTION

Ryberg is revolutionizing healthcare with cutting-edge UV-C technology. Designed for efficiency, built for impact. Omnia UV-C Disinfection Robot is an autonomous data driven Robot eliminating pathogens with unrivaled precision.

Founded in 2020, Ryberg leads the fight against healthcare-associated infections and antimicrobial resistance. Advanced engineering meets smart automation.



Introduction

Healthcare-associated or hospital-acquired infections (commonly referred to as HAI) are a serious, growing threat to patient safety worldwide. At any given time, approximately one in every 25 patients has contracted an HAI after a routine healthcare procedure. These infections may range from mild to moderate, but are sometimes severe and can become life-threatening or life-changing. HAIs stemming from the most serious antibiotic-resistant bacteria can lead to sepsis and death. In the United States alone, HAIs affect 2 million patients per year, resulting in over 100,000 deaths, and account for medical costs estimated between \$96B - \$147B annually.(1)

Pathogens most often associated with HAI include *Clostridium difficile* (*C. diff.*), Methicillin-resistant *Staphylococcus aureus* (MRSA), and Vancomycin-resistant enterococci (VRE). In addition, an alarming spike in the number of incidents of *Candida Auris* (*C. auris*), a multi-drug-resistant yeast that spreads by person-to-person transmission or through contact with contaminated surfaces, is being closely tracked and reported throughout the world.(2,3)

One of the most powerful and effective tools to aid in the control and mitigation of HAI is the use of UV-C irradiation (also referred to as ultraviolet germicidal irradiation, or UVGI). In 2016, the U.S. Centers for Disease Control and Prevention (CDC) concluded that based on a study of the benefits of enhanced 'terminal room disinfection,' the incidence of HAI-causing organisms could be reduced up to 35% by incorporating UV-C-based disinfection strategies alongside standard cleaning protocols.(1)

The mechanism for pathogenic microbe and virus inactivation through UV-C irradiation is relatively straightforward: UV-C irradiation induces damage to the genomes of bacteria and viruses by breaking bonds and forming photodimeric lesions in nucleic acids, DNA, and RNA. These lesions, in turn, prevent both transcription and replication, ultimately leading to inactivation, which prevents microorganisms and viruses from infecting and reproducing.

Therefore, any comprehensive approach to improved infection prevention should include UV-C irradiation in conjunction with conventional physical and chemical cleaning. UV-C disinfection can be deployed throughout healthcare facilities in a variety of ways. For air disinfection, upper-room UV-C systems can neutralize airborne pathogens. For surface disinfection, UV-C technology can enhance standard cleaning by inactivating bacteria and viruses that persist on high-touch areas. Studies have demonstrated significant reductions in MRSA and aerobic bacteria when UV-C disinfection is added to manual cleaning.(4)

It is precisely this remarkable versatility and adaptability that makes UV-C irradiation such an ideal addition to infection control programs. UV-C systems can be installed in various configurations within healthcare facilities to provide enhanced pathogen reduction, effectively helping to lower the risk of HAIs.

Overview of UV-C Irradiation for HAI Prevention

The primary goal of any disinfection program is to limit the spread of disease, which can significantly impact an individual's health and well-being. Additionally, HAIs place a significant financial burden on global medical systems, patients, and healthcare providers. Beyond the financial implications, the personal burden upon infected patients is often long-term and particularly challenging.

One case highlights the arduous journey of an HAI patient: Mary Millard, M.Ed, an advocate and public speaker, has shared her experience to raise awareness about HAIs and their lasting impact.(5)

"Personally, since the fall of 2014, I have undergone 89 X-rays, 20 CT scans, and 4 more procedures. This is in addition to monthly blood draws and cultures, as well as 16 visits to the hospital. Thanks to a





hospital-acquired infection, this is what life has turned into. In addition to costs to the healthcare system of preventable HAIs, there's a real cost—financial as well as quality of life—to the survivors."

Traditional cleaning and disinfection techniques may not always eliminate all viruses and pathogens from surfaces. For example, alcohol-based disinfectants are effective against many bacteria and viruses but are not effective against bacterial spores and certain viruses. Similarly, Quaternary Ammonium Compounds (QACs) are effective against many gram-positive bacteria and fungi but are less effective against gram-negative bacteria and bacterial spores.

Some pathogens are extremely resilient and can withstand chemical disinfection. *C. diff*, for example, is notorious for its ability to resist various chemical disinfectants and is recognized as one of the most challenging healthcare pathogens to eradicate.⁽⁶⁾ *C. diff* produces spores capable of surviving harsh conditions for prolonged periods.

The CDC's report, *Antibiotic Resistance Threats in the United States, 2019*, classifies *C. diff* as a major health threat. In 2017, there were an estimated 223,900 cases among hospitalized patients and 12,800 deaths in the United States.⁷ Additionally, Yale School of Medicine recently estimated that two-thirds of *C. diff* infections originate in hospitals, long-term care facilities, or other healthcare settings.

Similar concerns exist for VRE and MRSA, with VRE alone accounting for over 54,000 infections and a 10% mortality rate in 2017.⁽⁸⁾

Standard manual cleaning remains an essential step in any infection control program, and improved training, new protocols, and specifically focused Environmental Services (EVS) teams have made strides in overcoming previous deficiencies. However, variations in cleaning practices, improper use of disinfectants, and missed surfaces contribute to the persistence of pathogens.

Numerous studies have shown that the failure to adequately disinfect patient rooms during terminal cleaning increases the risk of HAI transmission when new patients are admitted to rooms previously occupied by individuals colonized or infected with multidrug-resistant pathogens.⁽⁹⁾

UV-C disinfection helps mitigate these risks by reducing inconsistencies in manual cleaning. UV-C systems can be deployed throughout healthcare facilities, often operating autonomously to disinfect surfaces and air efficiently. UV-C irradiation within the 200–280 nm range effectively inactivates bacteria, viruses, and other microbes by disrupting their DNA structure, preventing replication and infection.

By complementing terminal cleaning protocols, UV-C technology enhances infection prevention efforts and reduces variability in disinfection practices. UV-C systems amplify the effectiveness of manual cleaning by environmental services teams, reducing the burden of HAIs in healthcare settings.⁽⁹⁾

Conclusions

Healthcare-associated infections (HAIs) occur when patients contract infections during medical care or procedures. HAIs result from pathogens present within healthcare environments, including hospitals, acute care and long-term care facilities, ambulatory surgical centers, and end-stage disease facilities. Bacteria, fungi, viruses, spores, and other pathogens are responsible for HAIs. ^(10,11)

HAIs remain a significant cause of illness and death worldwide, with serious financial and medical consequences. At any given time, approximately one in 25 U.S. patients develops an HAI due to a healthcare-related event. In mainland China, a systematic review suggests an HAI prevalence of 3.12%, with rates as high as 26.07% in adult ICUs. ⁽¹²⁾ These infections result in hundreds of thousands of deaths and cost healthcare systems billions of dollars annually. Many global health agencies, including the U.S. Department of Health and Human Services (HHS), prioritize reducing HAIs.

While manual cleaning remains a cornerstone of infection control, limitations in effectiveness highlight the need for complementary disinfection technologies. UV-C irradiation offers a powerful solution for air and surface disinfection, reducing reliance on chemical agents and minimizing pathogen transmission. UV-C systems provide consistent, autonomous disinfection, supporting environmental services teams in achieving comprehensive infection control. By incorporating UV-C technology into healthcare settings, facilities can enhance patient safety and significantly reduce the impact of HAIs.

This text is based on an existing white paper: Defeating the High Costs of Healthcare Acquired Infection (HAI): Protecting Patient Health with UV-C Technology. James Clements Director of Channel Management, Product Marketing, Excelitas Technologies® Corp. December 16, 2022

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