Ryberg Omnia®

360 UV-C disinfection

Whitepaper:

Maximizing UV-C Efficiency: A Strategic Approach to Infection Prevention in Hospitals

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.

Executive Summary: Hospital-acquired infections (HAIs) pose a significant challenge in healthcare settings, leading to increased patient morbidity, prolonged hospital stays, and higher healthcare costs. Effective disinfection strategies are crucial to mitigating these risks. UV-C light has been widely recognized as a potent method for reducing pathogens on surfaces and in the air. However, the efficiency of UV-C disinfection depends heavily on factors such as distribution, intensity, and exposure duration.

This white paper explores the impact of optimal UV-C distribution on infection prevention in hospitals, focusing on the innovative design features of the Omnia UV-C disinfection robot. Key attributes include 360-degree UV-C distribution, dynamic mobility to reduce shadowing, close-proximity disinfection for improved efficacy, and emission of UV-C wavelengths near the germicidal optimum. Additionally, the integration of a forced airflow system is examined for its role in minimizing airborne pathogen transmission.

1. Introduction: The Role of UV-C in Hospital Infection Control

Hospitals are high-risk environments where maintaining a sterile atmosphere is crucial to patient safety. HAIs account for thousands of preventable deaths annually and impose a considerable financial burden on healthcare systems worldwide. Traditional cleaning methods, such as manual wiping with disinfectants, can leave residual pathogens that contribute to infection spread.

UV-C light, with wavelengths between 100 and 280 nm, has been demonstrated to deactivate a broad spectrum of pathogens, including bacteria, viruses, and fungi, by disrupting their DNA and RNA structures. Studies confirm that UV-C technology is highly effective in reducing microbial loads on surfaces and in the air, significantly improving hospital hygiene and patient safety (Anderson et al., 2017; Rutala & Weber, 2016).

However, the effectiveness of UV-C disinfection is influenced by key factors:

- Intensity: Sufficient UV-C energy is required to ensure microbial inactivation.
- Distribution: Uniform coverage is essential to prevent shadowed areas where pathogens may survive.
- Exposure Duration: Longer exposure times improve efficacy but must be balanced with operational efficiency.

2. Design Features of Ryberg's Omnia UV-C Disinfection Robot

Ryberg's Omnia UV-C disinfection robot is engineered to maximize UV-C Distribution, ensuring comprehensive pathogen inactivation while minimizing operational disruptions.

2.1 Even UV-C Distribution in All Directions

Key Features:

- Eight Symmetrically Positioned Lamps: A 360° lamp configuration ensures uniform UV-C Distribution, reducing the likelihood of untreated shadowed areas. The robot's 1.2-meter lamps provide extensive high- and low-level coverage, targeting frequently touched surfaces such as bed rails, doorknobs, and medical equipment.

- Optimized Height: The robot's height is designed to maximize exposure to critical areas within hospital rooms.

Impact on Infection Control:

- Comprehensive Coverage: Ensures high-touch surfaces are thoroughly disinfected.
- Reduced Shadow Formation: The symmetric lamp configuration minimizes areas where pathogens could evade exposure.

2.2 Dynamic Mobility for Enhanced Disinfection

Key Features:

- Automated Movement: Unlike stationary UV-C devices that require manual repositioning, the Omnia robot autonomously navigates through hospital environments.
- Intelligent Path Planning: The robot identifies obstacles and optimizes its route to ensure thorough exposure of all surfaces.

Impact on Infection Control:

- Reduced Shadowing: Movement allows for exposure of previously blocked surfaces.
- Labor Efficiency: Eliminates the need for manual intervention, reducing the risk of user error.

2.3 Close-Proximity Disinfection for Improved Efficacy

Key Features:

- Minimal Distance Operation: The Omnia robot can function within 15 cm of objects, enhancing UV-C intensity.
- Narrow Pathway Navigation: Capable of maneuvering through hospital corridors as narrow as 80 cm.

Impact on Infection Control:

- Higher Pathogen Inactivation Rates: Close-range operation increases UV-C exposure, leading to more effective microbial elimination.
- Energy Efficiency: Proximity reduces the need for excessive UV-C power, optimizing battery life.

3. Optimal Germicidal Wavelength for Maximum Effectiveness

The germicidal efficacy of UV-C is highly dependent on wavelength. Research indicates that 260 nm is the most effective for microbial inactivation, as it corresponds to peak DNA absorption (Dai et al., 2012).

Key Features:

- Emission at 253.7 nm: The Omnia robot operates at a wavelength close to the germicidal optimum.

- Non-Penetration of Glass: Unlike broad-spectrum pulsed xenon UV light, 253.7 nm UV-C does not pass through glass, ensuring focused disinfection.

Impact on Infection Control:

- Maximized Pathogen Elimination: Ensures high disinfection efficiency.
- Enhanced Safety: Prevents unintended UV-C exposure in adjacent areas.

4. Forced Airflow for Enhanced Pathogen Control

Airborne pathogens present a significant infection risk, particularly in enclosed hospital settings. The Omnia UV-C robot incorporates a forced airflow system that enhances airborne pathogen control.

Key Features:

- Upward and Downward Airflow Circulation: Channels air through UV-C exposure zones before recirculating it into the room.
- Minimized Airborne Spread: Designed to limit the transmission of pathogens through air currents.

Impact on Infection Control:

- Reduction of Airborne Pathogens: Improves air quality and lowers transmission risks.
- Comprehensive Disinfection: Enhances the effectiveness of surface and air pathogen removal.

5. Conclusion: The Future of UV-C Disinfection in Hospitals

Ryber's Omnia UV-C disinfection robot represents a significant advancement in infection prevention. Its innovative design—featuring optimized UV-C distribution, autonomous mobility, close-proximity disinfection, and forced airflow—ensures superior efficacy in pathogen elimination.

As hospitals continue to confront infection control challenges, the integration of advanced disinfection technologies like Omnia UV-C robot will play a pivotal role in reducing HAIs, improving patient outcomes, and enhancing overall hospital safety. Ongoing research and technological advancements in UV-C disinfection will further refine and expand its applications, ensuring that healthcare facilities remain at the forefront of infection prevention.

References

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