Smart, Healthy Hospitals

The Future of Automatic Disinfection in Healthcare

Table of Contents

Introduction

Whether we like it or not, germs surround us every day and far too often cause illnesses that could have been prevented. There are an estimated 720,000 healthcare-associated infections each year, costing billions of dollars in unnecessary medical expenses.

While progress has been made in decreasing the risks to patients, there are still far too many illnesses. According to the CDC, about one in 31 hospital patients has at least one healthcare-associated infections.

This white paper lays out the challenges that we face in helping keep healthcare facilities safe from harmful germs and how advancements in automatic UV disinfection technology will change the way we think about protecting these environments.

Role of the Environment in Healthcare Associated Infections

Historically, the role of the environment in the transmission of diseases was underplayed or at least not well understood. However, ample evidence now exists that demonstrates the contributory role that environments can play in the transmission of healthcare-associated infections (HAIs).

One critical factor to the transmission of pathogens via the environment is that many of them can persist on surfaces for hours, weeks, months, and even some reports of years. For example, the survival time for MRSA has been documented to range from 7 days to 12 months, and up to 46 months for VRE.[1]

With bacteria and viruses needing very few particles to infect a patient (10-100 particles for norovirus), it is critical that patient care areas are effectively disinfected. Studies have also shown that harmful pathogens may persist between patients even if terminal cleaning protocols were followed. For example, in one study, 16% of hospital room surfaces were positive for VRE, even though the protocols were followed for disinfecting rooms with a previous VRE-positive occupant.[1]

In fact, it has been shown that a patient's risk for contracting an HAI increases by a factor of 3.5 if the room has previously been occupied by a patient infected with *Acinetobacter buamannii*, 2.5 for C. *diff*, 2.25 for VRE and 1.5 for MRSA. This increased risk is attributed to the environment since there is no direct contact between patients.[1]

Moreso, if facilities are unable to effectively treat all rooms when there was a known infection in a prior patient, what happens when a patient hasn't yet been identified as having an HAI? One study found MRSA in 43% of beds of individuals not known to have contracted MRSA.[1]

> "It is now recognized that the environment can facilitate transmission of several important health care-associated pathogens."
>
> *Stephanie Dancer, Department of Microbiology, Hairmyres Hospital*

Outbreaks of various diseases have been traced back to varying sources, including blood pressure cuffs, computer keyboards, thermometers and even the sink of a patient in a single room. Health care workers are also likely to come into contact with these contaminated surfaces, which increases the risks of transmitting bacteria or viruses to others.

Challenges in Maintaining Healthy Environments

Numerous studies have researched the effectiveness of traditional cleaning methods and found them to be lacking for various reasons. A study by Carling et al. examined patient rooms after routine cleaning and found only 47% of the surfaces had actually been cleaned.[1] Reasons for these findings have been linked with time pressure on staff to turnover rooms, training issues, and high turnover rate.

Staff are expected to assess the space, the type of surface, the risk of contamination and other factors to determine the appropriate cleaning method and/or chemical to use. For example, if a patient was known to be infected with a specific pathogen, the cleaning regimen may be altered to use a disinfectant specifically known to kill that pathogen. However, as referenced previously, pathogens such as MRSA or VRE are frequently in patient rooms or on mobile equipment without the knowledge of the cleaning staff.

Another challenge with disinfectants is that they may require extensive contact times - up to 10 minutes that a surface needs to remain visibly wet to be effective. Not only is this a challenge from a time perspective, but if chemical disinfectants are not used properly and leave pathogens behind, those microbes can build resistance to that specific disinfectant, leading them to be less effective over time. For example, surfaces have been shown to remain contaminated with VRE after repeated attempts at cleaning, withstanding even double bleach-based cleaning.[2]

The cleaning process or materials themselves can also become sources of transmission. For example, mops, wipes, or other cloths can become contaminated rapidly if they are not changed frequently enough, and then in turn actually transfer pathogens from one place to another instead of killing them.

Given the challenges in effectively managing the environmental risk from both the sheer number of surfaces to be disinfected, but also resistance of certain pathogens to manual cleaning methods, enhanced disinfection methods have become essential.

Benefits of Enhanced Disinfection

Much of the evidence around the relationship between the environment and HAIs has occurred from studies determining if enhanced cleaning and disinfecting of the environment resulted in decreased infection rates for various pathogens.

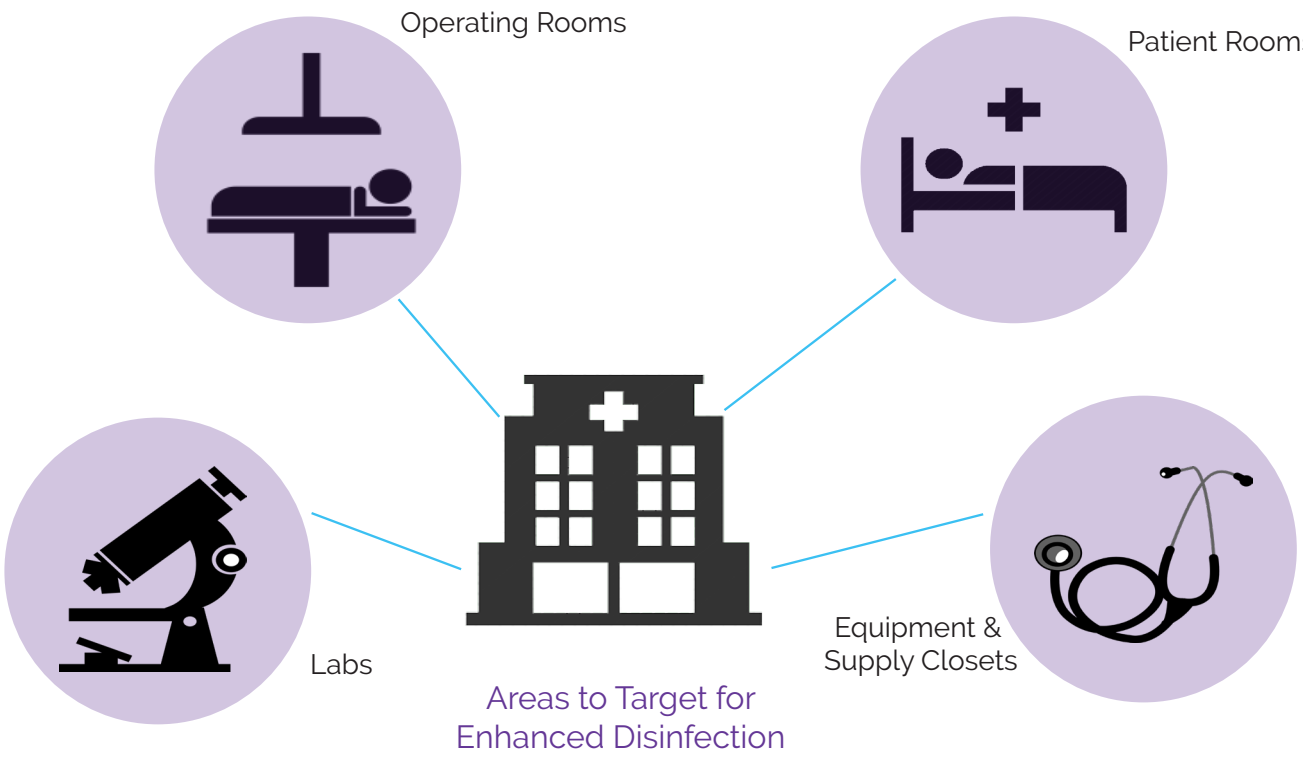
In a study investigating the role of enhanced cleaning, researchers found a decrease in the contamination of surfaces with MRSA and VRE (27% in enhanced cleaning vs. 45% at baseline). During this time period, the acquisition of MRSA was also reduced by 49%, indicating relationship between improved disinfection with decreased risk for infection.[2]

Additional studies have been deployed that test the effectiveness of individual interventions or the cumulative effect of multiple strategies, such as adding the use of ultraviolet light to chemical disinfectants. Ultraviolet light has been researched for over a hundred years for its ability to effectively kill pathogens in the air and on surfaces. UV light actually attacks the DNA and/or RNA of pathogens and as such, microbes have not developed any resistance to this approach, unlike certain chemical disinfectants.

A University of Wisconsin-Milwaukee study found that the addition of a pulsed Xenon ultraviolet disinfection device was "superior to cleaning alone for decreasing microbes on environmental surfaces, as well as decreasing infection rates, and the rates of hospitalization for infection."[3]

Another study conducted by the Duke University School of Medicine and the UNC School of Medicine researched the effect of several enhanced disinfection methods including the addition of UV to Quat and UV to bleach. All of the enhanced interventions were significantly superior to Quat alone.

In fact, the combination of Quat with UV resulted in a 94% reduction in epidemiologically-important pathogens, which led to a 35% reduction in the infection rate.[4]



The Future of Disinfection

UV light has been gaining traction as one of the leading techniques for enhanced disinfection, both from its history of effectiveness (sunlight has been killing germs since the beginning of time), but also from its ability to automate the process, removing some of the challenges and pitfalls of manual cleaning.

While automated disinfection cannot replace routine daily cleaning, as organic soil, liquids, trash, etc. must still be manually removed, UV disinfection systems offer an enhancement to traditional cleaning systems and have been proven more effective than chemicals alone to reduce surface contamination and ultimately decrease unnecessary infections.

Many early studies about incorporating UV into healthcare environments expressed concerns about the cost-benefit of some of the solutions available with mobile "robots" costing up to $125,000 per unit. These units are also extremely large (i.e. 5' tall, 150 pounds) and require full-time staff to move them throughout a hospital. Time studies on these devices have found a median time of 50 minutes per room to deploy them by the time you account for transport, multiple activations per room, and time spent waiting for a room to be available.[5]

Combining these factors makes them unrealistic and inaccessible to some facilities due to budgetary restrictions alone, but may also mean they are not feasible for use in other potential areas of transmission, such as supply closets, labs, and other spaces.

Smaller installed solutions using visible blue and white light offer another alternative, but they are only effective at killing bacteria and can take several weeks of continuous exposure to significantly reduce bacterial loads.

What would happen if you could have a small installed solution with the germ-killing power of the larger UV "robots"? It is now possible to install pulsed Xenon UV lights to automatically activate anytime a space is unoccupied. This provides opportunities throughout a hospital for enhanced disinfection, including food preparation areas, bathrooms, and storage areas. Built-in UV lights in patient rooms and operating rooms could be activated with the flip of a switch, making them an easy way to knock down the microbial load in a patient room anytime it's empty (i.e. when a patient is out of the room for an X-ray) or as part of the terminal disinfection process between patients after manual cleaning has occurred.

But with the connected hospital of the future, the automated UV disinfection systems can go a step further by being integrated with building management systems. Facility managers are now able to schedule enhanced disinfection cycles, manually activate the UV lights on demand, or monitor data on the frequency and duration of UV disinfection cycles throughout the hospital.

This is truly automatic, cost-effective UV disinfection as the units can operate without the need for additional labor and can be incorporated easily into existing cleaning protocols - providing better outcomes for patients without adding to ongoing labor costs.

Conclusion

With growing concerns of drug-resistant organisms, insufficiency of manual-only cleaning methods, and loss of efficacy of certain chemical disinfectants, it is critical that healthcare facilities have alternate solutions to help them tackle the bacteria and viruses that lead to unnecessary and costly infections.

However, solutions cannot be so cost prohibitive that few hospitals can even afford them, let alone the ongoing labor costs to add to terminal cleaning only. What if we could implement an automatic UV disinfection solution that is safe, effective, affordable, and offers more frequent disinfection whenever and wherever it's needed?

When healthcare-associated infections are costing billions of dollars each year and too many lives are being lost, how can we afford not to implement this type of solution?

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